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Science

Paricutin on Its Fifth Anniversary

(See page 635)

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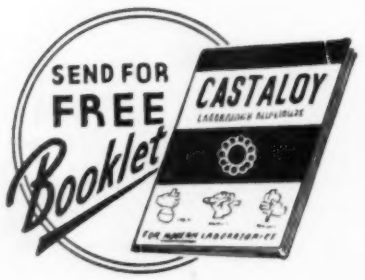

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CONTENTS

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The Fifth Anniversary of Paricutin

Frederick H. Pough

The American Museum of Natural History, New York City

FIVE OBSERVERS FROM MEXICAN AND American institutions visited Parícutin on February 20, 1948, its fifth anniversary, to see what the volcano's activity was at that time and, in a sense, to make an occasion of the anniversary. The scientists at the observatory were Dr. Ezequiel Ordonez, former head of the Instituto de Geología of Mexico, and Ing. Genaro Gonzalez Reyna and William Swoboda, both of the Instituto. The Americans were Ivan Wilson, Ray Wilcox (permanent observer), of the U.S. Geological Survey, and the writer.

The American Museum of Natural History has made a motion-picture record of the growth of the volcano, and the chief reason for the trip at this time was to record the changes that have taken place in the two and one-half years since the last expedition. Since a new film, now in preparation, is to be presented this summer at the 18th International Geological Congress in London by Ing. Gonzalez, W. F. Foshag, of the U. S. National Museum, and the writer, it was desired to bring the record up to date.

Many changes were noted in the volcano and the surroundings, though the activity did not differ greatly from that previously recorded. There appears to be a diminution of the quantity of gas, and the peaks of activity are of brief duration. Tremendous quantities of lava have flooded the base of the cone, burying it in approximately 100 meters of basalt, and lava continues to pour out of the flank of the cone. A recently developed vent was producing a lava stream at the time of the visit. This vent, a few meters above the base of the cone, is on what is obviously a fracture line which bisects it. It is not far distant from the old Zapicho vent of 1944, but all traces of that old cone are now gone, for it has been buried in the lava. At the time of the last previous visit a low hill to the north of the cone was a prominent landmark; its development as a rafted portion of the cone had been noted earlier. Nearby it, a persistent fumarole constantly emitted a cloud of steam. Both of these peaks are now buried, although the higher still protrudes slightly as a monadnock in the lava stream. It is reminiscent of the opening in the lava in the Pedregal, just outside of Mexico City, where a pre-eruption temple is to be seen in such a window in the lava. The persistent fumarole still gives its column of steam, escaping through the lava of the new flow though beneath another layer of rock.

The Observatory now occupies the top of the highest ridge, which forms an ash-covered moribund forest island in a sea of lava. The flow observed from the present vent, christened *Thiporocua*, threatens to override the ridge and destroy the cabin, which can hardly retreat further. Erosion on this ridge, and on Conijuato and other nearby slopes, has been intense. Landslides have tumbled the trees as the decay of the roots and stumps have weakened their hold on the hillside and as the ash load has grown thicker. Gullies are cut well below their old level, down into the pre-Parícutin soil. All vegetation has been killed near the volcano, but its radius of devastation does not appear to be spreading. Pear and apple trees were in bloom in the remnants of San Juan, only a few meters from the now dead lava front. Pines and oaks had suffered more than some of the other trees. An almost buried maguey was still alive after almost five years of ash deposits, and the opuntias and pines near the GSA cabin seemed as healthy as ever. The impression is gained that the radius of plant destruction is now very well limited and that little more damage will be done, however long the eruption continues.

The lava flows, too, pile one on the other and appear to be unable to extend themselves much beyond their present maxima. Cooling and the migration of the activity to a new vent both play a part in this. After a time, instead of spreading further, the flow breaks out in a new place and covers an earlier flow. The indication is very strong that a century of activity at Parícutin would do little more damage than a few years. The showers of ash falling on more distant spots are too sparse and become too mixed with organic matter to be anything but beneficial.

Some changes were noted in the cone itself. Although it is apparently no higher than on the last visit, the burial of its base more than counterbalancing any growth, in February it was marked by a deep fissure at the base of which, on the Zapicho side, the lava is now flowing. Until recently it has been escaping on the other side. This activity has split the crater so that the north and south edges are much higher (perhaps 100 feet) than the east and west edges. The rift extends down the cone as a groove, a feature which would tend to disappear if no lava issued from it and there were no movement, because the natural effect of this fissure is to throw the bombs down the low sides. Consequently, also, standing in the high edges and looking into the crater is now less nerve racking.

The crater, now very steep near the summit, flattens slightly about 50 meters down, before dropping

abruptly off to the vents. Although several vents were noted, the overhang prevented the party from seeing into them. Steam appeared to be the principal product. Great quantities of it drifted from the vents, were ejected in pulsations with great force, and were accompanied by red bombs from the main vent. The steam from this vent rose 5 meters or so before losing its force and spreading into a cloud, thus making it possible to see into the opening. The odor of gas, probably SO_2, was very strong by the crater. This was the more remarkable because S has not been noted in any quantity at Parícutin.

The explosive activity and the ejection of bombs were extremely variable. Usually the bursts were infrequent, and little was thrown over crater edges. From time to time, however, brief bursts of activity at night provided spectacles comparable to those in the early days of the eruption. These continued for 5 or 10 minutes at the most and occurred only a few times during the night. On the night of the 20th, however, the activity was such that all traces of the route followed by the scientific party in their ascent of the cone were completely obliterated.

The cone has changed somewhat and now presents to the casual glance a ridged appearance which has increased since it was last observed. During the climb it was noted that the fluting was more apparent than real. The lighter-colored, sliding places are composed of larger fragments, up to several inches in diameter, while the darker, lower areas are composed of smaller pea-sized fragments. These are self-perpetuating, the larger fragments stopping the tumbling ones which cross the firmer spokes. As they grow, they tend to slip and pile up small talus cones at their bases. Their present appearance assures their future as ridges when erosion takes its toll of the dead Parícutin, some years from now. Rain will wash through the loose fragments and escape slowly, while it will run rapidly off over the surface of the smaller fragments and start its erosion. The upper part of the cone is free of the fluted effect, the long trails of loose fragments commencing about one-third of the way down. The ashes of this section of the cone are very hot just beneath the surface and can burn the fingers only a few inches down. This section of the cone steams after a rainfall or a shower of condensed vapor like that noted on the afternoon of February 20—a shower which undoubtedly originated in the plume above Parícutin itself.

Temperatures appear to be about the same at the lava vents. The Parícutin lava has never flowed rapidly, even at its hottest, and the fountains that have been observed have been composed of very viscous material. The Fifth Anniversary party was very fortunate in being able to observe two magnificent displays of lava fountains. The first which took place at about five o'clock on the morning of the 20th, was seen from the Observatory. The lower vent began to chuff, the sound resembling the chuffing of a laden steam engine, with the exception that here each successive escape of gas was of different intensity, so that the "engine" lacked the regularity and rhythm of a freight engine. The sound was loud enough to wake Sr. Ordonez, who roused the others. The fountain was of a brilliant yellow-orange color in the darkness and rose perhaps 20 meters in the air. The display which lasted approximately 3 minutes, rapidly reached a peak and then died down. After a few more heaves in the following 15 minutes the flow fell back to its former quiet lava emission. The only sound that was heard from the cabin was that of the escaping gas.

A second fountain was observed by the entire party from very close range at 2:30 o'clock in the afternoon. The prevailing wind forced us to thread our way along the edge of the cone and in the small depression that bordered the advancing lava at the flank of the cone. From nearby, the *boca* was seen to be extruding lava at a regular rate, rising and falling slightly as the quantity increased or diminished. From time to time the surface rose sharply to a level of about a meter higher than normal level. The sinking was accompanied by an escape of gas, which sometimes threw a few small fragments into the air. About 15 meters above this *boca* an upper flow was seen to be producing some lava which very slowly moved down to an intersection with the flow escaping from the lower vent. The lava from the upper vent was black and showed red only in the deeper crevices. No gas was noted from this vent.

A few minutes after the party moved to the upper vent for a better view, the lower lava flow began to roar spasmodically, making the same noise that was noted during the night, and the lava heaved more violently. With hardly more warning than this, the whole center rose in a tremendous column of rather viscous lava, in a fountain perhaps 6 meters across and 10 meters high, from which fragments flew as high again in the air. The lava of this fountain was very viscous, and the fragments did not thin themselves out to glassy fibers but remained in massive chunks of some thickness. As they fell, they plastered themselves against the bordering rocks and remained as they were, without flowing away.

As the vigor of the fountain increased, the column rose higher in the air, accompanied by a steady roar of escaping gas. At its peak it rose to the level of the upper *boca*, perhaps 16 to 18 meters in all. The entire display lasted for probably not over a minute, the fountain then subsiding almost at once to its former level. Several times afterward the level of the flowing lava rose and fell, sometimes getting very low so that

the channel was almost drained of lava, a full 3 meters below the normal level, and then rose again. There were a few further heaves, and for a moment a crevice just above the flowing mouth gave a violent jet of gas and dust, but no good fountains succeeded the warnings, and the flow became very quiet.

From the behavior of the lava and the heaving at the *boca* it is possible to say that escaping gas, not hydrostatic lift, is the cause of the fountaining. The rising of the lava at a mouth is a very common phenomenon at Parícutin, though it does not often fountain. Usually the gas escapes from many crevices in the surface of the big bubble before the bubble actually breaks. The display of the 7 simultaneous fountains observed on the Taqui side in 1944 still seems to hold the record for number and duration. One fountain, the closest to the cone, remained active there for almost half an hour after the rest had stopped, even though it was one of the later ones to develop.

On the evening of the 20th it was noted that the center of activity of the *boca* had migrated up the slope, apparently to the formerly quiet upper level. Lava was flowing rapidly from that mouth and down a steep slope, which remained incandescent for 100 meters or more during the night. The profile of the flow changed from a terraced two-step arrangement to a single steeper lava rapids. The front advanced rather slowly, in the usual blocks of various sizes, none immense, and the lava seemed to be pooling behind, breaking forth more rapidly somewhere else after it had built up sufficient pressure. This is a familiar phenomenon at Parícutin.

The expedition was unexpectedly successful in achieving a double result. It was possible not only to make the obvious observations and note the changes since the last visit, which constituted the primary goal of the geologists, but also to make closer observations on the flow and the cone than had been thought possible. The lava fountain observed from such a close range was mere good fortune. No further fountaining was observed during the visit, and it would be difficult to choose so propitious a time again.

Experimental Research Into Psychosomatic Phenomena in Medicine[1]

Stewart Wolf[2]

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PSYCHOSOMATIC MEDICINE IS CONCERNED with bodily disorders related to problems of adjustment of the personality to adverse life situations. The term psychosomatic medicine is not satisfactory, but since it has already come into common usage the world over, there is little profit in continued controversy concerning its acceptance.

Observation of the relationship of disease to social adjustment has always been an essential part of good medical practice. Only in the relatively recent past, however, through the work of Pavlov (*4*), Cannon (*1*), and others (*9*), has it become evident that psychosomatic phenomona are amenable to the experimental approach. Opportunities to pursue experimental investigations of such phenomena have not, as yet, been widely exploited by physiologists, chemists, or clinical experimenters. It must be evident, however, that while in psychology, as in mathematics and physics, many developments have been intuitive or theoretical, the facts of psychosomatic medicine eventually must be gathered in conformity with the same biologic criteria which are applied to any pathologic process.

Recently attempts to explore psychosomatic phenomena have afforded important data in support of the rapidly growing realization that the tissues of the body have only a limited number of ways in which they can react to noxious stimulation. The intense interest in pathology during the latter part of the last century had led to the notion that specific agents cause lesions of specific character in the organs. In fact, diseases of unknown origin were often classified on the basis of differing appearance of lesions under the microscope. More recently, however, it has been established that tubercles may be produced by agents other than the tubercle bacillus, and that even Aschoff bodies in the myocardium, formerly regarded as specific to rheumatic fever, may follow a variety of noxious experiences (*6, 7*). The work of Selye (*8*) has

[1] Abstracted from the Annual Lectures to the Atlantic Clinical Society, March 25–26, 1948, Atlanta, Georgia.

[2] Aided by grants from the Hofheimer Foundation and the Commonwealth Fund.

added impetus to the gathering body of evidence against the old pathologic concept that specific agents give rise to pathognomonic tissue disturbances. His data support the concept that the organism is capable of reacting to noxious events with a limited number of patterns of defense involving one or more organs or organ systems (*10*).

Clinically, the concept of the "nonspecific" patterns of reaction gains support from study of the bodily changes incident to chronic exposure to arsenic. Manifestations of arsenic poisoning may include lachrymation and photophobia, turbinate swelling, rhinorrhea and nasal obstruction, dry mouth, headache, nausea and vomiting, diarrhea, joint pains and swelling polyneuritis, weakness, weight loss, hypotension, renal insufficiency with hypertension, anemia, pigmentation, keratosis, and even carcinoma of the skin (*3*). Most of these disturbances may be induced, not only by arsenic, but by other noxious agents, chemical, physical, or bacterial. Many have been described as part of psychosomatic reactions.

Already available data from recent experimental work concerning psychosomatic processes relate to headaches, nasorespiratory, cardiovascular, and gastrointestinal disturbances. Recent investigations of vasomotor rhinitis serve to illustrate the research methods which have been used and to exemplify what has been learned concerning physiological mechanisms and their modifiability (*2*). The nasal chambers of a large number of normal human subjects and individuals suffering from vasomotor rhinitis were examined directly with the aid of a nasal speculum. Roughly quantitative observations were made of the degree of swelling of the turbinates and septal membranes, their color, the amount of secretion, and the degree of obstruction to air passage. While the nasal structures were under observation, the individuals were exposed to one of a series of noxious experiences.

Muscosal hyperemia with swelling of the turbinates, hypersecretion, and obstruction followed exposure to cold, the inhalation of irritating dust, pollens, chemical fumes, and the application of painful stimuli to parts of the body remote from the nose—even as remote as the reminder to the patient that he is caught in the toils of an unhappy marriage. These nasal disturbances gave rise to discomfort with sneezing and even to pain which radiated along the zygomata and about the eyes in the distribution of "sinus headache." Individuals subject to frequent colds or to attacks of "vasomotor rhinitis" serious enough to cause complaint reacted to these various stimuli more than did "normal" individuals unaccustomed to nasal complaints. In many of the patients with vasomotor rhinitis, especially of the nonseasonal variety, it was possible to correlate most of their episodes of nasal disease with periods of considerable emotional conflict. To check further the relevance of the adverse life situation, these subjects were interviewed during periods of relative relaxation and security. At such times their nasal changes were minimal. Observations of the nasal structures were maintained throughout a suitable control period, and then the presumably sensitive topic was introduced abruptly into the conversation. Repeatedly it was possible thereby to induce experimentally hyperemia, swelling, hypersecretion, and obstruction with their usually accompanying symptoms of sneezing and feelings of fullness and pain.

Arterial tension has been raised with accompanying diminution in renal blood flow following diverse kinds of stimuli including exercise, breath holding, cold, and situations provocative of frustration and anger (*5*). Moreover, profound changes in form and function and cellular response of the mucous membranes of the stomach, colon, bladder, and vagina have been induced by similar noxious stimuli including symbolic ones (*11*). Psychosomatic medicine is concerned with the occurrence of such organic disturbances and structural lesions in response to threats to the security of the individual.

It was possible in some of the patients to modify this morbid chain of events, interrupting, for example, a nasal disturbance by sympathetic handling and intelligent application to the individual's problems. The chief methods have been to afford the patient (1) warm, sympathetic, and attentive support, (2) an opportunity to ventilate his feelings without fear of censure or reprisal, (3) suggestions for a reorientation of attitude, and (4) advice and help in making it possible for the patient to rearrange the actual life situation. The most satisfactory results occurred when it was possible to interrupt the habitual pattern of reaction and induce the individual to deal more constructively with his problems and conflicts.

It has become clear that mechanisms invoked by the human personality to deal with problems of adjustment to its environment may either underlie or modify any disease process. Thus, an understanding of psychobiology is indispensable to the preparation of any physician and should receive, in medical schools, an emphasis comparable to that now given to physiology and anatomy.

The study of psychosomatic phenomena is, however, more than a point of view. While it is desirable for any physician to take into account the peace of mind, aspirations and fears of his patients, profitable study and advance of knowledge will depend upon the acquisition of special techniques, training, and experience. To determine whether such studies lie within the category of medicine or psychiatry is no more important than to inquire whether the phenomena of

ionization lie within the field of chemistry or physics. The various categories of medical specialization were made for convenience and not for the purpose of limiting the horizon of medical development. Psychosomatic medicine is becoming not a medical specialty, but a discipline of human biology which will draw from its roots. wherever they may lie among man-made categories of interest. As such, and because of the variety and prevalence of its manifestations it should attract the attention of more and more serious and productive workers in chemistry and physiology as well as in clinical science.

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Obituary

George Grant MacCurdy
1863–1947

On November 15, 1947, the beloved founder of the American School of Prehistoric Research was killed by a passing car as he stepped from his own near Plainfield, New Jersey, to ask road directions. He and Mrs. MacCurdy were motoring south, where they intended to spend the winter.

Dr. MacCurdy was the son of a Georgia planter who moved to Warrensburg, Missouri. He attended the State Normal College at Warrensburg, but he was able to pay for his education only by numerous long interruptions in his studies during which he taught school. When he needed more money for tuition, he would set out on a horse or even on foot, his valise in his hand, to look for work. On his first job, in 1881, he was paid $22.50 a month. But he rose with astonishing speed to be a principal, and at 26 was a superintendent of schools.

In 1891, with the help of a scholarship, he found himself admitted to Harvard with advanced standing. He devoted himself at that time to geology and biology, though Professor Putnam, then director of the Peabody Museum at Harvard, almost persuaded him to take up anthropology. That decision was to come later. He took his A.B. in 1893 and his M.A. the following year. During the summer of 1894 he was the guest of Alexander Agassiz at his biological laboratory at Newport. This was followed by four years of study at Paris, Vienna, and Berlin and intensive foreign travel that included even Turkey and Russia. In 1896 Dr. MacCurdy attended the International Zoological Congress in Leyden, at which du Bois first exhibited the bones of *Pithecanthropus.* This so fired his imagination that he determined to devote himself exclusively to anthropology and prehistoric archaeology.

On his return from Europe, Dr. MacCurdy became associated with the Peabody Museum at Yale, where he received his Ph.D. in 1905 and where he remained until he became professor emeritus in 1931. Under his curatorship the collections of anthropology and prehistoric archaeology at the Museum grew enormously and were catalogued with scientific skill. He also continued to travel widely and to keep in close touch with scientific developments abroad.

From 1910 to 1912 he spent part of his time in New York cataloguing and arranging for exhibition the prehistoric collections from the Old World at the American Museum of Natural History. As a result of this, he was offered an appointment in the Department of Anthropology there, but, since he preferred to stay at Yale, he declined.

During his whole career Dr. MacCurdy was a prolific author, as the immense list of his published works indicates. It is safe to say that no other scholar outside the Old World has made so many notable contributions to the study of its prehistory. Though he was chiefly interested in the Old World, he also traveled widely in the New World and wrote authoritatively on American subjects.

Of Dr. MacCurdy's many books, the most celebrated is, of course, his *Human origins,* which appeared in

two volumes in 1924. While not the first great manual of prehistory to appear in America—Osborn's *Men of the old Stone Age* had been published 7 years previously—*Human origins* is of far wider scope. Many new discoveries have, of course, been made in the intervening decades, but *Human origins* is still an invaluable mine of information about discoveries made up to 1924, and it remains a great monument on the long road that scholarship has traveled in the search for Man's beginnings.

In 1921 Dr. MacCurdy, with Mrs. MacCurdy and Charles Peabody, founded the American School of Prehistoric Research. It was at first called the American School in France for Prehistoric Studies, but interest was later directed to Europe in general and finally to the whole of the Old World. For 8 seasons Dr. and Mrs. MacCurdy themselves conducted the summer trip for students to European museums and sites and also carried out excavations, the most notable of which was that of the Abri des Merveilles in the Vézère Valley where the famous Mousterian tools of rock crystal were found. After excavation of that site was concluded in 1930, Dr. MacCurdy turned over most of the work abroad to others, though he continued to direct the remarkably successful series of excavations in which the School participated in the Danube Valley and in the Middle East. The most notable of these was the Neanderthaloid necropolis at Mt. Carmel, containing the oldest complete skeletons of Man discovered up to that time.

Even after 1930 Dr. MacCurdy continued to travel abroad. During these last trips, which were like a royal progress, he attended banquets and receptions, presided at congresses, and replied to addresses of welcome.

Dr. MacCurdy also edited the School's *Bulletin* until he retired as director in 1945, and under his editorship many papers of scholarly importance appeared in it.

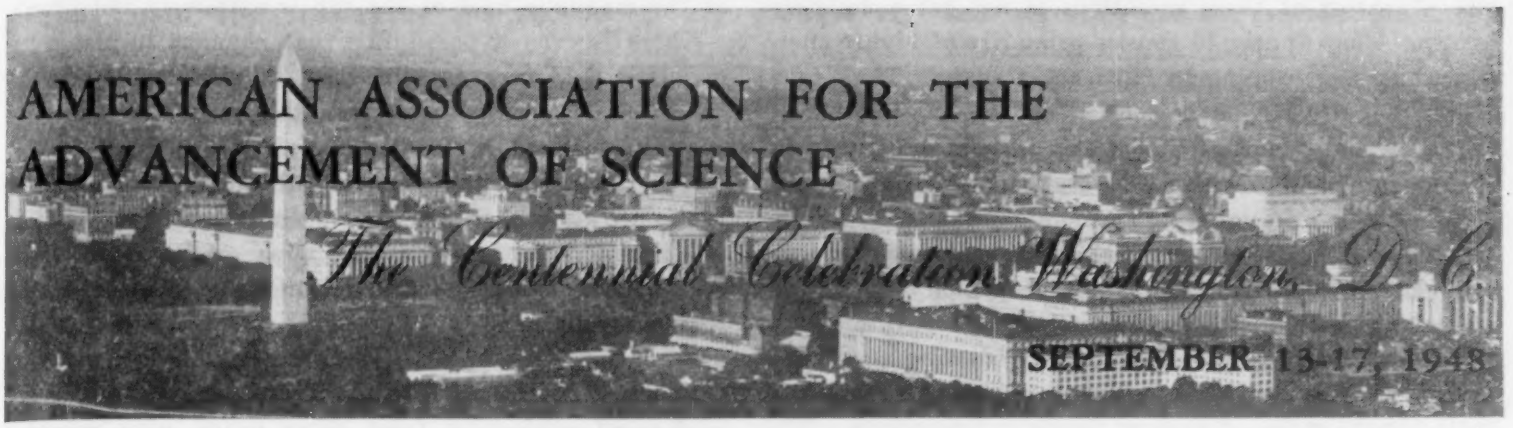
During later years, cooperation with the Peabody Museum of Harvard became more and more a feature of the School's activities, and the School's collections were eventually transferred to that Museum. This development grew from the strong ties that had always existed between the School and Harvard. Charles Peabody, one of the co-founders of the School, was curator of European Archaeology at the Peabody Museum at Harvard, and E. A. Hooton, of the Department of Anthropology, and Donald Scott, the director of the Museum, have long been Trustees of the School.

Dr. MacCurdy was the recipient of many honors during his long life. The one that pleased him most, however, was his election in 1946 to the vice-presidency of the Archaeological Institute of America. He was also one of the founders of the American Anthropological Association, which he served as secretary from 1903 to 1916 and as president in 1930. He was also a vice-president of the International Congress of Prehistoric and Protohistoric Sciences and a permanent member of its committee. When the Academy of Natural Sciences of Philadelphia held its International Symposium on Early Man in 1937, he was a member of the organizing committee and was chosen to edit the volume entitled *Early man,* in which the papers appeared.

Though George Grant MacCurdy was in many ways a New Englander at heart, he was of southern origin, and his scholarship possessed a courtliness and charm that has vanished in our hurried times. He was also a man of culture in the widest sense, devoted to nature, music, and the arts, and never for a moment became the narrow slave of science. He had an amazing capacity for friendship and for half a century knew every important scholar and private collector in his field in Europe and could command their unlimited service on behalf of the School for "conferences," as he liked to call lectures, and for guidance to museums, sites, and excavations. Among the host of scholars that he knew and visited abroad were Hoernes, Manouvrier, the de Mortillets, Montelius, Sophus Müller, Obermaier, Breuil, Sir Arthur Keith, the two Evanses, Haekel, Penck, Boule, Salin, and Sergi.

HUGH HENCKEN

American School of Prehistoric Research



Symposium on Problems of the Earth's Gaseous Envelope

This symposium will feature "The Sun and the Earth," by Donald H. Menzel, of Harvard University, "Meteorology of the Upper Atmosphere," by Carl G. Rossby and Hurd C. Willett, of the University of Chicago and Massachusetts Institute of Technology, and "Cosmic Rays," by Marcel Schein, of the University of Chicago. With respect to the symposium Dr. Menzel writes:

During the past decade interest in the upper atmosphere has been rapidly mounting, for many reasons. For the first time in history, some scientists are able to carry on direct exploration of the higher atmosphere. The V-2 and similar rockets, which reach heights in excess of 100 miles, have carried a wide assortment of instruments for measuring physical conditions in the tenuous air at high levels.

The structure of the upper atmosphere is highly complicated. Scientists have recognized the existence of a number of specific layers, but the composition and nature of these layers change from minute to minute, from season to season, and even from year to year. One of the most significant of these layers, at least from the standpoint of meteorology, is a region that contains a very appreciable amount of ozone. A molecule of ozone, which consists of three atoms of oxygen bound together by chemical forces, strongly absorbs the ultraviolet radiation from the sun. In addition, it cuts out large slices from the solar infrared. The total energy cut out by the ozone layer tends to heat the surrounding volume of gas. Thus, the layer of maximum ozone content is warmer than any of the regions immediately above or below.

The amount of ozone tends to vary with the season and with solar activity. We are still relatively ignorant concerning the precise character of the equilibria of the ozone layer. Nor do we know what role the ozone plays in the over-all problem of atmospheric circulation. Perhaps studies of the ozone layer will contribute to the solution of the problem of long-range weather forecasting. Certainly, the layer acts like a blanket, sending radiation that warms the earth.

Well above the ozone layer lies the "ionosphere," which consists of several layers of electrified gas. Ultraviolet radiation from the sun is again responsible for the electrification. The high-energy radiation pulls electrons away from atoms and molecules in the region. Presumably, each individual ionospheric layer arises from some given chemical constituent of the atmosphere. The lowest layer of the ionosphere, known as the E layer, probably comes from the ionization of the oxygen molecule. The two other main layers, the F_1 and F_2, probably arise from ionization of the oxygen atom and the nitrogen molecule, respectively. Scientists have recently suspected the existence of a still higher layer, the G layer, the existence of which is tentatively attributed to ionization of nitrogen atoms.

The density of electrification in the various ionospheric layers changes diurnally, seasonally, and annually. Superposed on the more or less regular variations are the disturbances, frequently sudden, caused by solar activity. Knowledge of the nature of the ionospheric layers is extremely important for practical reasons. The ionosphere reflects radio waves around the surface of the earth, making possible long-distance radio communication. Advance knowledge of the occurrence of disturbances is important for the planning of communication schedules, especially since some frequencies are more affected than others by the disturbances.

There are numerous other phenomena of the upper atmosphere which are closely related to solar activity. Among these are the problems of the aurora polaris and of the continuous auroral glow that keeps even the darkest of skies from being perfectly black. These illuminations derive their energy directly from the sun, either from converted ultraviolet radiation or, possibly, from high-speed particles ejected from active solar areas.

Thus, the sun becomes an important factor in the understanding of physical conditions in the upper atmosphere. Observations indicate that the 11-year sunspot cycle has associated a variability of many solar features other than spots. These include changes in the activity of prominence explosions, the form and intensity of the solar corona, and—what is perhaps most important from the terrestrial point of view—a marked change in the amount of emitted ultraviolet radiation. New solar programs, to develop improved indices of solar activity, are already under way. These studies should provide information of great benefit to students of atmospheric problems.

Cosmic rays are another interesting and important phenomenon of the upper atmosphere. The origin and pre-

cise character of these radiations is not yet completely known. They appear to consist primarily of highly energetic particles, coming in from outer space. Thus, in a sense, they are not phenomena of the upper atmosphere. However, the scientists observe them most effectively in that region, and we have the best chance of observing them in their original state at the highest levels. As the rays descend, the filtering action of air molecules changes the characteristics of the powerful primary rays into secondary particles of lesser energy.

Cosmic rays possess sufficient energy to disrupt atomic nuclei. Thus, scientists consider them one of the primary tools for the study of nuclear forces and reactions. The short-lived mesons, whose masses are intermediate between those of electrons and nuclei, are of special interest.

Because of the fact that primary cosmic rays—some of them at least—possess a positive charge, the magnetic fields of the earth and the sun exert a focusing action upon the radiations. For this reason a redetermination of the magnetic field of the sun is extremely important.

There is even a possibility that changes in the solar magnetic field may, in some way, be responsible for the origin of cosmic rays. However, this recently made suggestion is extremely tentative.

The rapidly accumulating knowledge of conditions in the upper atmosphere will be especially useful at the time —which perhaps is not as far away as the more pessimistic have supposed—when jet or rocket planes may fly their way through the ionosphere. There is a decided acceleration of interest in the problems and information that comes from the indirect studies. Meteors, which are high-speed projectiles from outer space, give valuable data concerning the density, temperature, and pressure in the levels. The echoes of radio signals from the ionospheric layers contribute information of great value. Studies of terrestrial magnetism at high altitudes, measurement of brightness of the sky, and studies of solar radiation in general, all contribute to the knowledge.

NEWS and Notes

Leif Verner, who has been head of the Department of Horticulture at the University of Idaho for the past 14 years, will relinquish his administrative duties on July 1. He will be succeeded as department head by **James E. Kraus,** a member of the department since 1941. This change, effected at Dr. Verner's request, will enable him to devote full time to research and teaching in pomology.

Arthur W. Hixson, executive officer of the Department of Chemical Engineering, Columbia University, since 1940, retired this month. He has been succeeded by **Thomas B. Drew,** a member of the department since 1940 and a consultant to Brookhaven National Laboratory.

Charles M. Goss, professor of anatomy, School of Medicine, Louisiana State University, has been elected editor-in-chief of the *Anatomical Record.*

A. Henry Fretz, associate professor of geology at Lehigh University, will retire at the end of this month. Prof. Fretz has been a faculty member at Lehigh for the past 30 years.

Gottfried S. Fraenkel, lecturer at the Imperial College of Science and Technology, London, and widely known student of insect physiology, has been appointed professor of entomology at the University of Illinois.

F. Homburger, chief of the Department of Clinical Investigation and associate of the Sloan-Kettering Institute for Cancer Research, New York City, has been appointed research professor of medicine at Tufts College Medical School, Boston, and director of the newly created Cancer Research and Cancer Control Unit of the Department of Surgery. Beginning July 1 Dr. Homburger will have his office at the Joseph H. Pratt Diagnostic Hospital, 30 Bennet Street, Boston.

Carroll C. Pratt, professor and chairman of the Department of Psychology, Princeton University, received an honorary D.Sc. degree from Clark University at its recent Commencement exercises.

Robert B. Platt, of the Department of Botany, University of Pennsylvania, has been appointed assistant professor of biology at Emory University and will assume his duties in September.

Bryan L. Wade, director of the U. S. regional vegetable breeding laboratory in Charleston, South Carolina, has been appointed head of the Department of Horticulture, University of Illinois College of Agriculture. Dr. Wade succeeds **M. J. Dorsey,** head of the department for the past 8 years, who will retire on September 1.

Ivan E. Miles, director of the Soil Testing Division of the North Carolina State Department of Agriculture for the past 9 years, has resigned to become agronomist with the Extension Service of the Mississippi Agricultural Experiment Station, beginning July 1.

Hans A. Bethe, professor of physics at Cornell University, will join the Columbia University faculty as visiting professor in September. Dr. Bethe will give a graduate lecture course in advanced nuclear physics and a seminar on the theory of mesons. While at Columbia he will also join in the research work with the 400,000,000-volt cyclotron, now being completed at Irvington-on-the-Hudson.

Grants and Awards

A research program in adolescence, recently given support by the W. T. Grant Foundation, is to be carried on at Phillips Academy, Andover, Massachusetts, under the direction of J. Roswell Gallagher, school physician. The investigations will be in the fields of orthopedics, psychology, and physiology. It is contemplated that a yearly grant of $10,000 will be continued for a period of 5 years.

The Board of Trustees of the Rockefeller Foundation has made a grant of $45,000 to Princeton University for research on the psychology of perception, under the direction of Carroll C. Pratt. The grant covers a three-year period beginning June 1, 1948. Certain of the studies will be done in collaboration with Adelbert Ames, Jr., and will make use of apparatus which he has designed at the Hanover Institute.

The Association for the Study of Internal Secretions has just announced the following awards:

The Squibb award for 1948 has been conferred on Fuller Albright, of Harvard Medical School, who has made outstanding contributions on the functions of several of the hormones in man in health and disease. The Committee on Awards notes that "in many diseases such as hyper- and hypoparathyroidism, certain renal disorders, a variety of diseases of bone, and the diseases of the adrenal glands, our knowledge of internal medicine has been enriched by his investigations. Throughout his work his careful research methods and his lucid teaching have been a valuable stimulus to all his fellow students of endocrinology."

The Ciba Award for 1948 goes to Carl G. Heller, of the University of Oregon College of Medicine, "for his significant contributions to the study of physiology of reproduction, with particular reference to the diagnosis and treatment of disorders of reproduction in man."

The Ayerst, McKenna and Harrison Fellowship for 1948 has been awarded to Ernest M. Brown, Jr., of the George S. Cox Medical Research Institute, University of Pennsylvania. Dr. Brown will work with F. D. W. Lukens on the production of lesions of the islands of Langerhans.

Colleges and Universities

A large-scale research program in soils engineering, being sponsored jointly by Cornell University and the Office of Naval Research, will lead four engineer-investigators to widely separated parts of the world. Donald J. Belcher, Taylor D. Lewis, Charles H. Ladenheim, Raymond J. Hodge, and several graduate assistants in engineering and geology will head the field explorations in Greenland, Alaska, the Aleutian Islands, Europe, North Africa, and the United States. Results of these explorations will be combined with analyses of aerial photographs to determine requirements for construction equipment and the best construction methods for given areas. Soil engineers agree that this method may be used in the development of irrigation, drainage, or transportation systems and for the development of natural and agricultural resources. Emphasis will be placed on the main elements of soil characteristics in aerial photographs which are land form, surface drainage, erosion, and color. A staff of civil engineers and scientists, including several outstanding undergraduate students, are locating and defining land forms and planning a long-term program of exploration.

The Department of Botany, State College of Washington, has announced various additions to its staff which have been made since the beginning of the 1946–47 school year. These include R. F. Daubenmire, formerly of the University of Idaho, as associate professor (ecology); Adolph Hecht, formerly of the University of Chicago, as assistant professor (cytology); and Noe Higinbotham, formerly of the University of Notre Dame and Argonne National Laboratories, as associate professor (morphology). Arthur H. Cronquist, formerly of the University of Georgia, will join the staff September 16 as assistant professor (taxonomy). W. R. Hatch is chairman of the department.

The Goethe Link Observatory, built in 1939 on a high bluff near Brooklyn, Indiana, about 35 miles from Bloomington, by Dr. Goethe Link, of Indianapolis, has been given to Indiana University by Dr. and Mrs. Link. In addition, through the Goethe and Helen Link Foundation for Scientific Research, the University received a bequest of property, income from which will be used to maintain the observatory, the largest and finest in the state. Since its completion, the University's Astronomy Department, of which F. K. Edmondson is chairman, has worked closely with the observatory and has provided the service of James Cuffey, then a research fellow and now assistant professor. Dr. Link's policy of making the observatory available to as many people as possible will be continued, as will the series of public lectures which were inaugurated at his request. The University plans to add various pieces of equipment including a spectograph for use with the 36″ reflector and a 10″ wide-angle camera.

Summer Programs

The Fifth Annual Series of Summer Laboratory Clinics has been announced by the Institute of Polymer Research and the Division of Applied Physics, Polytechnic Institute of Brooklyn. The titles of the lectures and the dates for these clinics will be: June 28–July 9—Industrial Applications of X-Ray Diffraction, July 12–17—Advanced X-Ray Diffraction, August 9–13—Weight and Shape of Macro Molecules in Solution, and August 23–27—Polymerization Techniques. At the June 28–July 9 meeting registrants should have some background in physics, chemistry, and mathematics (including trigonometry), but no previous X-ray training will be expected. All standard techniques may be studied at this meeting. The July 12–17 laboratory course is offered to students who have attended previous summer clinics in X-Ray Diffraction. This course will range over a broad field, but each registrant will arrange in advance the subject matter of his own work. Some of the techniques offered for study are the Weissenberg goniometer, microcamera, small angle scattering, Fourier series, precision determination of lattice constants, and low temperature studies. The subject for discussion at the August 9–13 meeting will be experimental methods and theoretical evaluations of the different methods for molecular weight determination of polymers. For discussion and demonstration at the final meeting, August 23–27, the topic is laboratory techniques of polymerization in bulk, in suspension, and in emulsion. Latest experimental methods of obtaining polymers of high clarity and good color stability will be presented. Inquiries should be addressed to I. Fankuchen, Division of

Applied Physics, or H. Mark, Institute of Polymer Research, Polytechnic Institute of Brooklyn, 85 Livingston Street, Brooklyn 2, New York. Fees for the courses range from $100 to $200.

Reed College, Portland, Oregon, is preparing for its first Northwest Conference on Nuclear Science, to be held June 28–July 16. The broad program is designed to provide technical study for college and research laboratory scientists, a survey for high school science teachers, and orientation for laymen. Technical offerings are expected to cover elementary nuclear physics theory, properties of the elementary particles, elementary pile theory, nuclear physics instrumentation, radiochemistry, some problems and applications of nuclear physics and chemistry, and radiobiology and medicine.

The instructional staff will consist of three staff members of the University of Chicago's Institute for Nuclear Studies—Samuel K. Allison, director; Anthony Turkevich, associate professor of chemistry; and John A. Simpson, Jr., assistant professor of physics. Raymond T. Ellickson, who will succeed A. A. Knowlton as head of the Reed Physics Department next fall, will also be present.

Fellowships

The U. S. Public Health Service has announced that it will award a limited number of mental hygiene research fellowships for graduate work. These fellowships are open to psychiatrists, psychologists, social workers, anthropologists, sociologists, and others who have the proper qualifications. A predoctorate research fellowship carrying a stipend of $1,200 a year ($1,600 a year for those with dependents) is available to those with a bachelor's degree. For those with a master's degree or its equivalent in graduate work the stipend is $1,600 a year ($2,000 for those with dependents). Tuition will also be paid. Medical students who have completed one or two years of medical work may also apply. A postdoctorate research fellowship, to be awarded to qualified individuals holding a doctor's degree in medical or related fields, carries a stipend of $3,000 ($3,600 for doctors with dependents). Tuition fees are not included with this fellowship. Also offered is a special research fellowship to those who qualify for a postdoctorate fellowship and in addition have demonstrated outstanding ability or possess specialized training. This fellowship does not carry a set stipend, the amount being determined in the individual case. Application forms and additional information may be obtained from Division of Research Grants and Fellowships, National Institute of Health, Bethesda 14, Maryland.

Meetings and Elections

The Second Annual Symposium on Applied Mathematics of the American Mathematical Society will be held at the Massachusetts Institute of Technology, Cambridge, July 29–31, with the co-sponsorship of the American Institute of Electrical Engineers, the American Institute of Physics, and the Institute of Radio Engineers. The subject of the symposium is "Electromagnetic Theory." Programs and information concerning accommodations will be mailed early in July to members of the American Mathematical Society and also to others who request them from Associate Secretary T. R. Hollcroft, American Mathematical Society, 531 West 116th Street, New York City 27.

The 25th Annual Plant Science Seminar will be held at the College of Pharmacy, University of Washington, Seattle, from Monday, August 2, until Thursday noon, August 5. The first day and a half will be devoted to scientific papers, discussions, and demonstrations, while the latter part of the meeting will be held in beautiful Mount Ranier National Park, where an excellent botanizing tour of the mountain has been planned. Ralph F. Voigt, University of Illinois College of Pharmacy, chairman of the Seminar, has appointed H. W. Youngken, Jr., local secretary.

The 334th meeting of the American Mathematical Society was held at Columbia University April 16–17. According to T. R. Hollcroft, associate secretary, there was an attendance of about 350, including 306 members. Sixty-three research papers were presented, 28 in person and 35 by title. The two invitation addresses, on "Mathematical Methods in Ancient Astronomy" and "Some Classes of Functions Defined by Difference or Differential Inequalities," were given, respectively, by O. E. Neugebauer, of Brown University, and Charles Loewner, of Syracuse University.

The Second Annual Eastern Colleges Science Conference, which was held at Union College April 23–24 and which had as its theme "Relationships Between Pure and Applied Science," was an extremely successful one. The approximately 150 undergraduates who attended were conducted on tours through the General Electric laboratories on Friday afternoon. The opening address of the Conference was delivered that evening by Leslie F. Nims, chairman of the Biology Department at Brookhaven National Laboratory, on "Biology—A Meeting Ground Between Pure and Applied Science." On Saturday, in addition to the series of papers presented in the fields of chemistry, physics, astronomy, biology, geology, and psychology by undergraduates from the participating colleges, there were demonstrations and exhibits, a talk by Vladimir Rojansky, chairman of Union College's Physics Department, and an address on "Atomic Energy—Some of Its Problems and Possibilities," by Harry A. Winne, vice-president of the General Electric Company. Plans were made for continuing the Conference next year.

The West Virginia Academy of Science held its 1948 meeting at Montgomery, West Virginia, April 30 and May 1, with the West Virginia Institute of Technology serving as host. Approximately 150 Seniors were in attendance and as many, or more, Juniors. The two groups met jointly for the annual banquet, at which time recognition was given to leaders and to prize-winning Juniors. The annual exhibit, or Science Fair, which included displays of scientific apparatus, experimental projects of both high school and college students, and publications of the AAAS, was by far the

most extensive exhibit ever sponsored by the West Virginia Academy.

J. E. Judson, in his presidential address, gave a very thorough and timely discussion of "The National Science Foundation Policy." The evening lecture was delivered by K. Lark-Horovitz, general secretary of the AAAS, who spoke effectively on "Science in a Free Society." This served as a most fitting climax to a worth-while meeting and as an impetus to the execution of future plans of the Academy.

Officers for the coming year are: president, Nelle Ammons, West Virginia University; vice-president, S. Benton Talbott, Davis-Elkins College; secretary, N. Bayard Green, Marshall College; and treasurer, A. H. Van Landingham, West Virginia University.

The Illinois State Academy of Science held its 41st annual meeting in Benton on May 7–8. Hurst H. Shoemaker, secretary, reports that 134 papers were presented in the 12 senior and collegiate sections to a record attendance of 500 persons. Eugene S. Richardson, Jr., of the Chicago Natural History Museum, spoke on "Major Features of Earth Structure" before 350 Junior Academy members. The banquet speaker on Friday evening was Kenneth A. Reid, executive director of the Izaak Walton League, who spoke on "Land and Water Management in the Public Interest." On Saturday over 100 persons took part in biological, geological, industrial, and archaeological field trips. Research grants totaling $260.50 were awarded to William M. Bailey, Bernard Greenberg, J. V. Karabinos, R. Maurice Myers, James M. Sanders, and Sister M. Christine.

Academy officers elected for 1948–49 include: Robert R. Paton, president; Claude U. Stone, vice-president; W. W. Grimm, treasurer; Hurst H. Shoemaker (University of Illinois, Champaign), secretary; Dorothy Rose, editor; and Thorne Deuel, librarian.

Resolutions were passed (1) urging the preservation of certain unique, small, natural areas in the state; (2) recommending a transfer of the conservation agencies of the state to a commission form of government; (3) recommending that the value of the bottom lands along the Illinois River for wildlife and natural basins for the storage of flood waters be considered before approval is given to engineering projects involving further levees and dams; (4) calling attention to the recent neglect of science teaching in our secondary schools; and (5) urging construction of a new State Museum Building.

Deaths

Ernest G. Merritt, 83, emeritus professor of physics at Cornell University, died June 5 in the Tompkins County Memorial Hospital, New York. Prof. Merritt, one of the original editors of *The Physical Review*, had also served as first dean of the Cornell Graduate School and headed the Physics Department from 1919 until his retirement in 1935.

C. Frank Allen, 96, civil engineer and former professor of civil engineering at the Massachusetts Institute of Technology, died June 6.

Edwin Lincoln Moseley, 83, professor emeritus of biology at Bowling Green State University, died June 6 in Bowling Green. Dr. Moseley had attracted national attention by his long-range weather forecasting studies.

Edwin A. Trowbridge, 63, dean of the College of Agriculture and director of the Agricultural Experiment Station at the University of Missouri, died in Columbia on June 7.

John C. Olsen, 78, former head of the Department of Chemical Engineering at the Brooklyn Polytechnic Institute and past president of the American Institute of Chemical Engineers, died June 8 in the Caledonian Hospital, Brooklyn.

William D. Funkhouser, 67, entomologist, head of the Department of Zoology and dean of the Graduate School of the University of Kentucky, died June 9 after an illness of 6 months.

William T. Corlett, 94, president emeritus of Western Reserve University Medical School, died June 11 in Cleveland. Dr. Corlett, formerly a professor of dermatology and syphilology at Western Reserve, was internationally known for his pioneer work in skin diseases.

Leslie Sandholzer, 44, director of the Interior Department's fisheries technological laboratory at the University of Maryland, died June 11 at Prince Georges County Hospital after a long illness.

A program of graduate study has been established at the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine. This program, which will be developed in cooperation with leading graduate schools, is designed to make available to qualified candidates for the doctor's degree the Laboratory's genetically unique stocks of mice, rabbits, and dogs. Students must satisfy residence and course requirements of the graduate school of their choice and must be sponsored in research by a member of the Jackson Laboratory staff. Current research at the Laboratory centers on the relation of genetics to normal and abnormal growth processes and to the development of social behavior. Some part-time assistantships are available. Inquiries should be addressed to Graduate Study Committee, Roscoe B. Jackson Memorial Laboratory, Box 78, Bar Harbor, Maine.

Make Plans for—

American Astronomical Society, June 28–July 1, Mount Wilson Observatory, Pasadena, California.

First International Poliomyelitis Conference, July 12–17, Waldorf-Astoria Hotel, New York City.

International Congress of Zoology, July 21–27, Paris, France.

General Assembly and International Congress of the International Union of Crystallography, July 28–August 3, Harvard University, Cambridge, Massachusetts.

American Veterinary Medical Association, August 16–19, Palace Hotel, San Francisco, California.

International Society of Photogrammetry, September 1–10, Amsterdam, Holland.

★ ★

AAAS
Centennial Celebration
Washington, D. C.
September 13–17, 1948

★ ★

Comments and Communications

A Useful Prefix for the Extension of a Systematic Nomenclature for Intact Polycyclic to Related Open-Ring Systems

The failure to assign systematic generic names to the open-ring systems closely related to the steroids has led to a confusing array of trivial nomenclature for their important derivative forms that completely masks the significant structural relationships which exist. Since the structural difference which obtains usually is merely the opening of one of the condensed rings of the cyclopentanoperhydrophenanthrene system, it would seem logical to devise a simple prefix which would denote this and allow the extension of the systematic nomenclature of the parent series to their derivative forms. Such a prefix is readily derived from the Latin verb *seco*, meaning "to cut," which is easily adaptable and exact in connotation. The use of this proposed convention allows the numbering system of the parent structure to be retained for the derivative ring system. Thus, for instance, the systematic generic designation of the bilianic acids formed by scission of the 3 : 4 bond of the A-ring in the cholane series would be *3 : 4-seco-Cholanic acids*, e.g. desoxybilianic acid = 3 : 4-*seco*-12-keto-3 : 4 : 24-tricarboxycholane; the generic name of the vitamin D series would be *9 : 10-seco-Cholestane*, e.g. calciferol = $\Delta^{5(6)\ :\ 7\ :\ 10(18)}$-9 : 10-*seco*-Cholestanetrienol-3 (α); and for the estrogenic acid series, formed by scission of the D-ring at the 16 : 17 bond, the generic designation would be *16 : 17-seco-Estranolic acids*, e.g. doisynolic acid = $\Delta^{1\ :\ 3\ :\ 5(10)}$-16 : 17-*seco*-17-carboxyestratrienol-3. (Compare present nomenclature, 1-ethyl-2-methyl-7-Hydroxy-1,2,3,4,9,10,11,12-octahydrophenanthryl-2-carboxylic acid.)

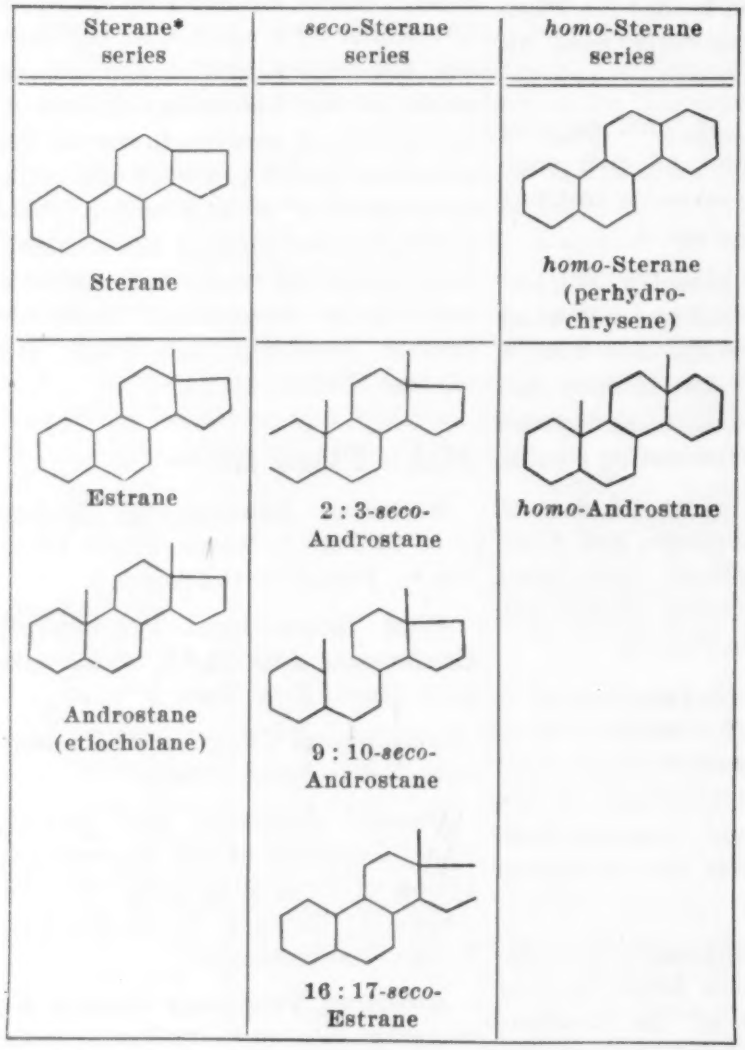


FIG. 1.

* This term is an obvious and useful simplification of the more cumbersome accepted terminology of cyclopentanoperhydrophenanthrene for the bare ring nucleus of the steroids, and in fact this term has been suggested previously by Sobotka (personal communication).

It is obvious that this prefix is of general advantage to systematic chemical nomenclature where it is neither feasible nor desirable to establish an entirely new nomenclature for such complex derivative ring systems, viz., of the steroids, porphyrins, and carotenoids. Although the simplified nomenclature thus allowed does not include stereochemical considerations, it does lend itself as well as any of the existing terms to stereochemical specifications by a system of prefixes to be worked out in the future.

Furthermore, the use of this form of nomenclature allows a very useful and consistent classification of the principal steroid structures, as shown in Fig. 1.

HERBERT JAFFE

Thorndike Memorial Laboratory, Second and Fourth Medical Services (Harvard), Boston City Hospital, and Department of Medicine, Harvard Medical School

National Science Foundation— A Peril or a Hope?

Most readers of *Science* are no doubt sufficiently familiar with the discussions which have gone into the proposal for a National Science Foundation and sufficiently familiar with the provisions of the present bill before Congress (H.R. 6007 and the identical Senate Bill S. 2385) to give proper discount to the perils of this legislation which have been set forth by John L. Rich (*Science*, May 14, pp. 505–506). Nevertheless, I cannot let his remarks go unchallenged.

The comments I wish to make may possibly not go far toward reassuring those who have no faith whatever that one can ever hope to find even a spark of intelligence in any branch of our Federal Government or in any of our universities. But if even a slight amount of such faith is granted, the provisions of the present bill would seem to warrant considerable hope that the perils which Mr. Rich describes can be avoided.

His first peril is "that the National Science Foundation itself will be controlled by politicians rather than

by scientists.'' Section 3a of the bill states that ''persons nominated for appointment as members (1) shall be eminent in the fields of the basic sciences, medical science, engineering, education, or public affairs; (2) shall be selected solely on the basis of established records of distinguished service; and (3) shall be so selected as to provide representation of the views of scientific leaders in all areas of the Nation. The President is requested . . . to give due consideration to any recommendations for nomination which may be submitted to him by the National Academy of Sciences . . . or by other scientific or educational organizations.'' It is hard for me to believe that a President of the United States would go contrary to such a clear directive.

The second peril is ''that the Director of the Foundation, because of his power to grant or withhold research funds, would come to exercise a very real control of university policies on scientific activities.'' Section 6b of the bill provides that the Director shall act only in accordance with policies developed by the Foundation, and under the directives of its Executive Committee. It specifically provides that the authority to enter into contracts shall be exercised ''with the approval of the Executive Committee.'' The Director thus is an Executive Officer of the Foundation and not a dictator in his own right.

Mr. Rich further fears that the funds will go principally to the larger educational institutions to the detriment of the smaller ones. It is to be expected, of course, that funds allocated for the support of research must go to places where there are research laboratories and research scientists. A million-dollar grant to the Podunk Junior High School will not automatically make it a great center of science. Nevertheless, the provisions of the Act specifically guard against serious danger of maldistribution. Section 4b provides that ''it shall be one of the objectives of the Foundation to strengthen basic research and education in the sciences . . . throughout the United States, including its Territories and possessions, *and to avoid undue concentration of such research and education.*''

The next peril mentioned is that university administrations will be subject and will yield to strong control from the Foundation. I personally am not acquainted with any college presidents who are willing to sell their souls, even for a few dollars.

Finally, Mr. Rich fears the consequences of universities undertaking ''projects set by outsiders,'' some of which ''may be of a secret nature.'' This, it seems, reveals a clear misunderstanding of the purpose and spirit of the Science Foundation Bill. The bill does not provide that the Foundation will draw up a list of research projects and farm them out to universities and other agencies. It seems to me obvious that the bulk of the research supported by the Foundation will be projects proposed by the universities themselves, rather than projects thought up by the Foundation and imposed on the universities. The Foundation has no power to impose its projects on any university. There is not even a financial incentive for universities to take on projects they do not desire, for every university administration knows that undertaking a new research project on a government cost contract does not result in any perceptible flow of gold into the general treasury. There is every expectation and provision that the Science Foundation will act in very much the same way as the Rockefeller Foundation, the Research Corporation, the National Research Council, and similar agencies which have done so much to forward scientific research in this country. The prescribed constitution of the Board itself would seem to assure this.

As to secret research, I find nothing in the bill which enforces security regulations other than a provision that the Foundation may initiate and support work relating to the National Defense. Clearly again each university is free to adopt its own policies as to whether it wishes to carry forward such research. In any case, the creation of the Science Foundation will be a distinct advance over the present situation, in which science depends so heavily on support from military agencies which are far more likely to insist on security restrictions than a civilian science board.

I am sure if one abandons the assumption that this bill empowers a mysterious and evil ogre known as the Federal Government to impose its ill-conceived purposes on innocent universities, rewarding the compliant ones with a generous flow of gold, and recognizes instead that the bill simply sets up a Board consisting of our scientific colleagues, charged with the responsibility to encourage and support science, the perils which Mr. Rich describes would seem to be reduced to manageable size. More than that, if scientists and university administrators render intelligent cooperation and aid to their colleagues on the Foundation Board, the perils can be avoided completely and the result can well be a significant and greatly needed impetus to scientific research and the training of scientists in this country.

L. A. DuBridge

California Institute of Technology

TECHNICAL PAPERS

Studies on Hypoproteinemia: III. Lymphoid Hyperplasia and Redistribution of Nitrogen Caused in Mice by Transplanted Tumors (Sarcoma 180 and Breast Adenocarcinoma EO 771)[1]

F. HOMBURGER[2]

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Previous studies in patients with gastric cancer have shown that severe hypoproteinemia may persist for long periods of time while synthesis of tissue proteins takes place in the organism (*4*). A similar situation may be encountered in tuberculosis (*8*), in certain types of kidney disease (*5*), and in idiopathic hypoproteinemia or dysproteinemia (*3*). This phenomenon could be explained by either a selective defect of the synthesis of plasma proteins or by shunts of nitrogenous compounds away from the plasma into the proteins of other tissues.

The present preliminary report deals with a systemic effect of a transplanted tumor on the nitrogen metabolism of the mouse. It will be shown that in mice the implantation of sarcoma 180 causes hyperplasia of the lymph nodes with a significant shunting of nitrogen into the lymphoid tissue.

Groups of male CFW mice were pair fed, and sarcoma 180 was implanted into the right pectoral region of the animals of the experimental series. The tumors were allowed to grow for 6 days in one group and for 12 days in another. A third series was given implants of a murine adenocarcinoma of the breast (EO 771) that was allowed to grow for 12 days. A control group received no implants. At the end of the experiment the animals were killed by bleeding from the carotid artery.[3] The lymphoid system (thymus, two axillary nodes and mesenteric nodes) was dissected,[4] weighed immediately, and then homogenized in physiological saline solution for the determination of nitrogen by a micro-Kjeldahl method. The weight and the nitrogen content of the lymphoid tissue were expressed in mg/100 gm of body weight at the end of the experiment.

Table 1 shows that there was some loss of body weight in the control group, a more considerable loss in the group bearing sarcoma 180 for 6 days, and a slight rise in the group bearing the same tumor for 12 days. In contrast, there was a marked increase in weight of the lymphoid tissue in the mice with sarcoma 180, accompanied by a rise in nitrogen content of the lymphoid tissue. Implantation of a murine adenocarcinoma of the breast (EO 771) resulted in comparable increase in weight of the lymphoid tissue, accompanied by a rise in nitrogen content which was considerably smaller. Statistical analysis showed that these changes were definitely significant (Table 2). Histological studies showed that

TABLE 1

CHANGES IN BODY WEIGHT, WEIGHT OF LYMPHOID TISSUE, AND NITROGEN CONTENT OF LYMPHOID TISSUE IN MICE BEARING SARCOMA 180 AND IN MICE WITH TRANSPLANTED ADENOCARCINOMA OF THE BREAST (EO 771)

Type of tumor	Days of experiment	No. of animals	Body wt. (gm) before experiment	Body wt. (gm) after experiment	Change of wt. (%)	Lymphoid tissue wt. (mg/100 gm body wt.)	Increase over normal (%)	Lymphoid tissue nitrogen (mg/100 gm body wt.)	Increase over normal (%)
None (Control)	12	12	*27.7* (25.4–38.4)	*26.6* (24.8–32.8)	− 4	*287* (149–560)	...	*6.2* (1.7–13.6)	...
Sarcoma 180	6	12	*29.0* (23.9–36.6)	*25.0* (20.5–32.8)	− 14	*779* (239–1,237)	+ 172	*23.9* (12.5–58.5)	+ 286
Sarcoma 180	12	12	*18.7* (12.8–24.0)	*19.5* (17.3–21.3)	+ 4	*588* (424–896)	+ 105	*14.2* (10.0–21.8)	+ 129
Breast tumor (EO 771)	12	12	.....	*23.7* (20.0–26.7)	..	*713* (500–1,070)	+ 148	*11.5* (6.8–18.8)	+ 85

The means are set in italic; the ranges are in parentheses.

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[2] Present address: 30 Bennet Street, Boston 11, Massachusetts. It is a pleasure to express thankful appreciation to K. Sugiura for implanting the tumors, to N. F. Young for performing the chemical analyses with the technical assistance of Miss E. Bloch and Miss I. Forbes, and to Aurelia Potor for her statistical evaluation of the data.

[3] This was necessary for the measurement of the plasma volume by the method of Furth and Sobel (*2*), which was done as part of a study on the general nitrogen distribution in blood, liver, spleen, carcass, tumor and lymphoid tissue of these animals, to be reported later.

[4] The lymphoid nature of the tissue studied was ascertained in some instances by histological examination.

e enlargement of the lymph nodes was due to simple yperplasia and that there were no metastases. Details this morphological study will be published later.

The interpretation of these findings must await the tcome of further analyses on the nitrogen content of her compartments in these animals. The relatively all increase in the nitrogen content of the lymphoid sue of mice bearing adenocarcinoma of the breast sugsts that in this case the lymphatic hyperplasia may be a different nature than that observed in the mice bear- sarcoma 180.

The data of Murphy and Sturm (*6*) showed opposite nds in the weights of cervical lymph nodes of rats aring a lymphosarcoma. This discrepancy of data obined in different species emphasizes the complexity of problem.

The findings of Savard (*7*) of adrenal hypertrophy in ce with sarcoma 180 and the parallelism between the servations of Dougherty and White (*1*) in adrenalectoized mice and our own data suggest the adrenal as a ssible mediator of the phenomenon. However, other tritional and hormonal factors must be investigated.

The experiments revealed a systemic effect on protein tabolism caused by transplanted tumors not usually nsidered to mediate endocrine mechanisms, and the ob-

TABLE 2

ANALYSIS OF VARIATIONS BETWEEN NORMAL AND TUMOR-BEARING MICE

	Mean	SEM	t value	P value
Nitrogen in lymph nodes and thymus (mg/100 gm body wt.)				
rmal	6.2	0.736		
rcoma 180 (6 day)	23.9	2.73	4.88	< .01
rcoma 180 (12 day)	14.2	0.87	5.54	< .01
east adenocarcinoma (EO 771)	11.5	0.82	3.74	< .01
Weight of lymph nodes and thymus (mg/100 gm body wt.)				
rmal	287	25.5		
rcoma 180 (6 day)	779	60.2	5.92	< .01
rcoma 180 (12 day)	588	22.9	5.61	< .01
east adenocarcinoma (EO 771)	713	28.3	7.55	< .01

rvations may provide a new approach to the tumor-host lationship in animals and man.

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Zeeman Effect and *g*-Values for Neutral Nitrogen and Oxygen

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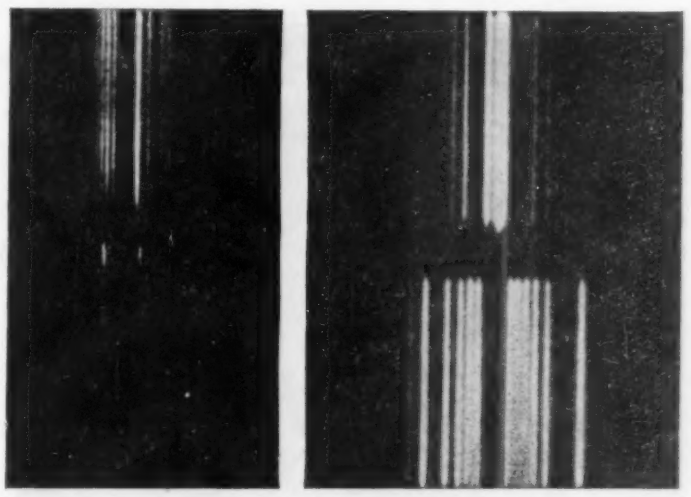
No *g*-values are available for the energy levels of atoms below 10, neon, except in the case of the ionized nitrogen and oxygen atoms. The reason for this is that the Zeeman patterns that have been reported are, for the most part, qualitative, or they are distorted. Recent Zeeman-effect observations of the red and infrared lines of various metals, made at the National Bureau of Standards and at the Massachusetts Institute of Technology, show the patterns of atmospheric nitrogen and oxygen lines as well. The nitrogen lines represent transitions from the terms $3p\ ^4D^\circ$, $3p\ ^4P^\circ$, and $3p\ ^4S^\circ$ to the lower term $3s\ ^4P$, while those of oxygen result from transitions from $3p\ ^5P$ and $3p\ ^3P$ to $3s\ ^5S^\circ$ and $3s\ ^3S^\circ$, respectively.

On the spectrograms made at the National Bureau of Standards, with magnetic field-strengths of 35,000 gausses, and on the MIT spectrograms, with fields in excess of 85,000 gausses the nitrogen and oxygen Zeeman patterns exhibit various degrees of distortion both in the positions and in the intensities of the magnetic components. The nitrogen patterns exhibit only slight dis-



A B

Fig. 1. Zeeman patterns of the oxygen lines at 7,771–74–75 A: A—34,660 gausses; B—85,400 gausses.

tortions or none at all. With the oxygen patterns the case is different: the quintet group, at 7,771–75 A, illustrated in Fig. 1, shows marked distortion at two different fields and bears no resemblance to either a weak-field pattern or to a Lorentz triplet; the triplet group, at 8,446 A, however, shows a nearly perfect Lorentz triplet pattern with very weak π-satellites also at the normal triplet separation.

The interpretation of these patterns has afforded an interesting application of quantum theory to the elucidation of the Paschen-Back effect. Because the splitting of the atomic energy levels in the field is of the same order of magnitude as the level separations when no field is acting, it is found that the magnetic sub levels of the same

quantum number push each other away from their normal positions and alter each other's transition probability. A calculation of the amounts of these shifts and intensity changes by means of the quantum formulas yields magnetic patterns in close agreement with those observed. The g-values that we have derived for the N I and O I energy levels conform, within observational error, to those required for LS-coupling, despite the fact that the term-intervals, except those of $3p\ ^4D^\circ$ of N I, do not conform to the Landé ratios.

Multicellular Hairs in *Gossypium*[1]

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The seed hairs of cultivated cotton (*Gossypium* spp.) are of two types: long fibers, which constitute the lint of commerce and which are removed in the ginning process, and short hairs, closely adherent to the seed, which are known as fuzz or "linters." The seeds of wild species of *Gossypium* differ from those of cultivated types in that they bear only one type of hair which varies considerably in length from species to species.

The developmental histology of lint and fuzz hairs in cultivated varieties has been studied by several workers.

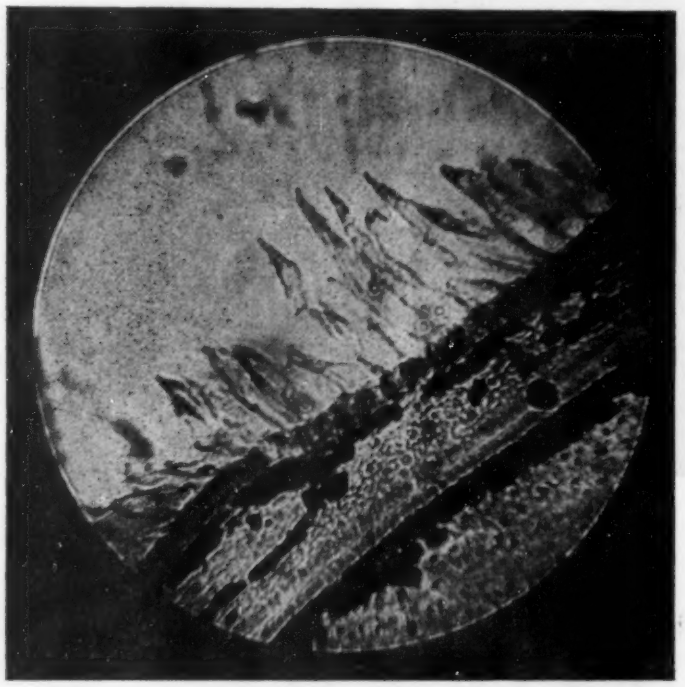

FIG. 1. Binuclear elongated epidermal cells of *G. hirsutum* ovules, fixed at 60 hrs after the flower opened (×675).

In 1881 Bowman reported that lint hairs were multicellular. Later, he (*2*) and all subsequent workers have indicated that both lint and fuzz hairs are unicellular outgrowths of the seed coat epidermis. Since the comparative morphology of lint, fuzz, and wild type seed

[1] Contribution No. 1106.

[2] Member of the Egyptian Education Mission in U. S. A., Cotton Investigations, Cotton Research Board, Giza, Egypt.

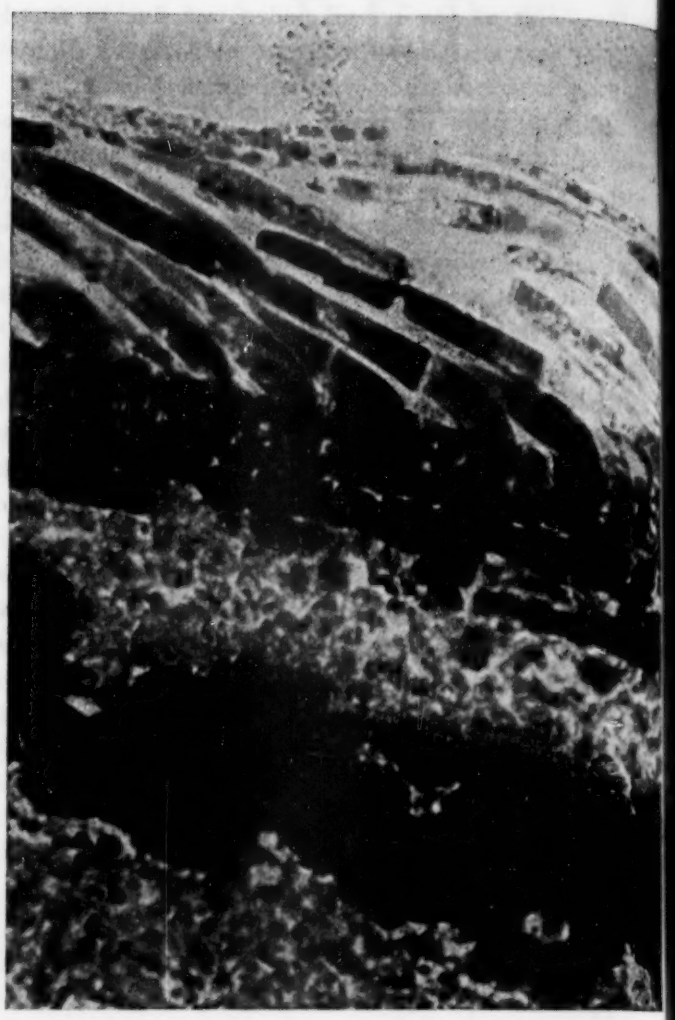

FIG. 2. Multicellular elongated epidermal cells of *G. klotzschianum* var. *davidsonii* ovules, fixed at 48 hrs after the flower opened (×1,050).

hairs is of considerable evolutionary and technical significance (*3–5*), a comprehensive study of the *Gossypium* genus as a whole has been begun at the Texas Agricultural Experiment Station.

This study was initiated during the summer of 1947 on upland (*G. hirsutum*) ovules taken every 2 hrs, beginning 16 hrs before the opening of the flower. Ovules were fixed in Navashin's solution as modified by Longlet (6) and embedded in paraffin. Microtome sections, 12 μ in thickness, were stained with iron gentian violet and mounted in Canada balsam. Studies were continued in the greenhouse during the winter of 1948 on 4 different species, samples being taken every 12 hrs. The results, which will be published in detail elsewhere, suggest a new interpretation of structure and development of seed hairs in *Gossypium*. They may be summarized briefly as follows:

(1) Both lint and fuzz originate at the same time and are distributed at random over the surface of the ovule, their initiation being independent of both pollination and fertilization (cf. *1*).

(2) Differentiation between fuzz and lint, based upon the diameter of the epidermal cell (*3*), general shape of the hair, and number of nuclei present, can be made as early as the time of flower opening.

(3) Examination of sections taken before flower opening suggests that the lint hair originates as a binuclear

FIG. 3. Mature fiber of *G. klotzschianum* var. *davidsonii* showing a cross wall (×4,850).

ll. Binuclear epidermal cells and, at a later stage, inuclear lint hairs were seen (Fig. 1). Subsequently, ne nucleus degenerates, at a time apparently dependent n the rate of cell growth.

(4) The seed hairs of a wild species, *G. klotzschianum* ar. *davidsonii*, are *multicellular* both in young and lder stages (Figs. 2 and 3). In mature fibers the cross

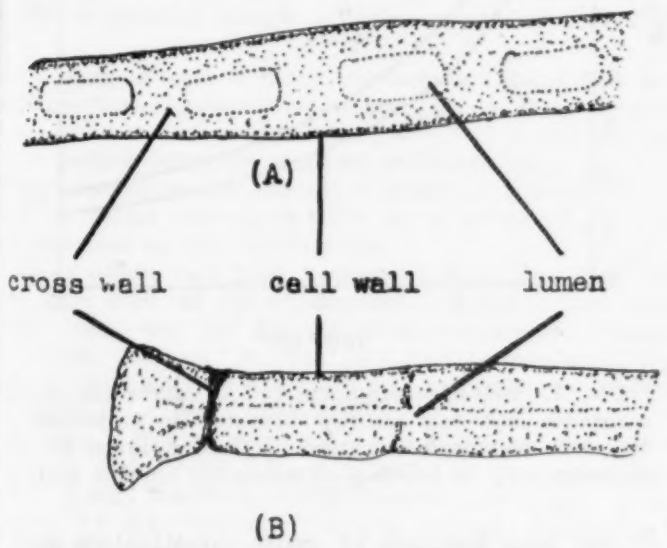

FIG. 4. Diagrammatic illustrations to show the mature fiber of *G. thurberi* (A) and *G. klotzschianum* var. *davidsonii* (B), suggesting the multicellular structure of the fiber.

walls are less thickened than the longitudinal walls, but re clearly visible toward the terminal end of the hair. Previously published illustrations (*5*) of the mature seed hair of another wild species, *G. thurberi*, suggest a similar basic structure in which the cross walls have been thickened to a greater degree. Thus, the lumen appears as a chain of "vacuoles" in an otherwise solid fiber (Fig. 4).

These results indicate that the unicellular lint hairs of cultivated cottons may be developmentally derived from multicellular wild type seed hairs through an evolutionary process that progressively reduced a primitive, strongly thickened, multicellular structure to a unicellular, partly thickened, long hair (lint) and a unicellular, strongly thickened, short hair (fuzz). From the standpoint of differentiation, the seed hairs of *Gossypium* can therefore be grouped as follows: (1) multicellular type, e.g. the seed hairs of *G. thurberi* and *G. klotzschianum*; (2) binuclear type (one nucleus subsequently degenerating), e.g. the lint hairs of cultivated cottons; and (3) uninucleate type, e.g. the fuzz hairs of cultivated cottons. It is possible that the seed hairs of the wild species, *G. anomalum* and *G. raimondii*, represent an intermediate stage between the multicellular and binuclear types shown above.

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The Relation of Backscattering to Self-Absorption in Routine Beta-Ray Measurements

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The enhancement of observable activity caused by reflection processes is said to be due to "backscattering." The intrinsic activity of a thin sample is increased by "exterior reflection" from the sample mount; that of a thick sample is further raised by "interior reflection" due to multiple scattering processes taking place within the sample itself. The latter effect is always observed as part of self-absorption, and therefore one compensates for it automatically when self-absorption corrections are derived from data obtained experimentally under conditions identical with those used in routine counting.

Beta radiations subjected to interior reflection can be divided arbitrarily into two groups: (a) some particles which start toward the counter are *deflected* away from

[1] This paper is based on work performed under contract No. W-7405-Eng-48 with the Atomic Energy Commission in connection with the Radiation Laboratory, University of California, Berkeley.

the sensitive volume; (b) others start away from the detector but are *reflected* back into the counter from some point in the sample. These two processes differ only in direction. *Deflection* has always been measured as part of the complex beta-ray absorption phenomenon; *reflection*, on the other hand, effectively adds more particles to the measurable flux and thus enhances the observed activity. At the surface of a thick sample the enhancement of the activity is due entirely to internal reflection, since deflection is negligible in the short air path between sample and counter. It can be shown that in deeper-lying layers of the sample this net enhancement is maintained despite the increasing importance of deflection processes.

The magnitude of the backscattering effect depends upon the nature of the sample and mounting and upon the energy of the radiations involved. When thick samples or mounts are used, the effect increases with their atomic numbers and with increasing beta-particle energy. The activity increase due to the mount is kept small by using backings which contain only the lighter elements, such as paper, Cellophane, Nylon, etc. (Accurate determinations of backscattering factors as functions of the solid angle subtended by the detector at the source have not been made. It is known that the size of the effect observed is dependent upon the geometry of the detection system, increasing with increasing geometric efficiency.) In order to gain information on the effect of backscattering upon self-absorption data, some experiments were performed which were designed to yield information concerning the relative backscattering powers of a number of substances at two different detection geometries.

A 4-μg sample of C^{14}-active barium carbonate was mounted over an area of 0.040 cm² in the center of a plastic film circle 20 cm in diameter and 0.07 mg/cm² thick; the sample layer was not thicker than 0.15 mg/cm². The aluminum equivalent thickness of the counter window and air path was 3.4 mg/cm² at the lower geometry (12%) and 2.3 mg/cm² at the higher (36%). The sample was first counted over 25 cm of air; then thick layers of various materials were maneuvered to within 0.05 mm of the back of the sample spot and the activity again measured. This enhanced activity, divided by that first observed, is taken as being equal to the backscattering factor of the substance in the thick backing layer at the geometric efficiency with which detection was carried out. The data are collected in Table 1.

From these data it is possible to make certain statements about interior reflection in samples of various thicknesses. Consider, first, a sample of radioactive barium carbonate mounted on aluminum and counted at 36% geometry. If one envisions the sample as made up of many thin layers, it is apparent that the observed activity of the first lamina (counting from the mount) is 1.16 times the intrinsic activity because the aluminum mount contributes an additional radiation flux to the measurement by exterior reflection. The activity observable from the next lamina is increased by slightly more than 1.16, for although fewer radiations can reach the backing, they are more powerfully reflected from the first barium carbonate lamina. Thus, as the samp thickness is increased, the activity rises from 1.16 to 1 times that observed when all reflection effects are n lected. If samples of active wax were used, the activ

TABLE 1

BACKSCATTERING OF C^{14} BETA-PARTICLES

Scatterer	Relative observed activity	
	12% geometry	30% geometry
Air	1.00	1.00
Platinum	1.43 ± 0.02	1.51 ± 0.02
Barium carbonate	1.30 ± .01	1.35 ± .01
Glass	1.16 ± .01	1.17 ± .01
Aluminum	1.15 ± .01	1.16 ± .01*
Paper (unsized)	1.04 ± .015	1.07 ± .015
Wax (artificial ceresin)	1.04 ± .015	1.07 ± .015

* Compare with L. D. Norris and M. G. Inghram. *Phys. Rev.*, 1948, **73**, 350.

observable would fall from 1.16 to 1.07 times t "no-reflection" strength because the interior reflecti power of wax is less than the exterior reflecting pow of aluminum.

Backscattering effects saturate very rapidly becau they involve double transit of radiations through absor ing layers. The maximum penetration thickness of C beta-particles is about 28 mg/cm²; yet the reflecti effects reach 80% of their maximum at a sample thickne of 6 mg/cm² and 97% at 12 mg/cm².

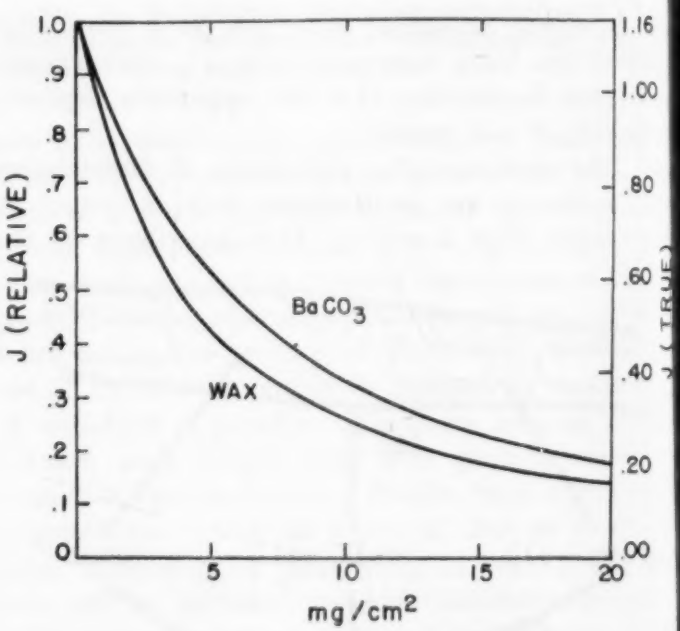

FIG. 1. Self-absorption correction curves for barium carbonate and wax samples, mounted on aluminum, as functions of sample thickness. (Data obtained at 30% geometry.) J is fraction of maximum specific activity.

It has been assumed by many investigators that t effective self-absorption corrections for several samp substances are very nearly the same as those for bariu carbonate, for which most such determinations have be made. That this is not the case can be seen by referen to Fig. 1, where data for wax and barium carbona samples, all mounted on aluminum, are graphed. (T active wax was prepared by dissolving in a large amou

artificial ceresin wax a small amount of *p*-phenyl-enacylacetate prepared from sodium acetate methyl-beled with C^{14}.)

A consideration of the reflection enhancement of the bserved radiation leads one to expect that, at sample icknesses where the backscattering effects are saturated, e curves for the two sample materials will be related to ch other by the quotient of the proper reflection efficients. The value predicted is $1.35 \pm 0.01/1.07 \pm 0.015$ 1.26 ± 0.02; that observed is 1.27.

Work is now in progress on a theoretical treatment of ese effects, as well as on experiments designed to ucidate their angular dependence and variation with article energy. A more complete report will be published sewhere.

L-Penicillamine as a Metabolic Antagonist[1]

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Because of the structural relationship of penicillamine β,β-dimethylcysteine) to the biologically important sul-r-containing amino acids, it occurred to us that peni-illamine might possess anti-amine acid activity. In in-estigating this possibility we found that when L-peni-illamine was added to the diets of young albino rats[2] rowth was inhibited. However, when cystine, cysteine, omocystine, or homocysteine were added to the diet, the ffect was not counteracted. In pursuing further the hought that penicillamine was a metabolic antagonist, e encountered the fact that choline was effective in ounteracting the toxic action of L-penicillamine.

This relationship of choline and penicillamine was then tudied in greater detail, utilizing a choline-free diet.[3]

When L-penicillamine hydrochloride hydrate was added in an amount to make 0.35% of this diet, which otherwise permitted good growth, an immediate loss in weight resulted. When 1.6% of choline chloride was subsequently incorporated in the diet, the loss in weight was counteracted. These animals then grew at the same rate as those on the diet to which no penicillamine had been added. Most of the animals receiving penicillamine but no choline died in a few weeks, although in a few cases the loss of weight was partially overcome and the animals lingered on. Apparently some animals are a little more resistant than others to the action of penicillamine, but all animals seem to be susceptible if sufficiently high levels of penicillamine are used.

Increased amounts of methionine in the diet were incapable of overcoming the effects of penicillamine under these dietary conditions. Dimethylaminoethanol and monomethylaminoethanol were next investigated and found to be effective. Aminoethanol itself was then tried and was found to be an even more effective agent than choline against the toxic effect of penicillamine. When any of the methylated derivatives of aminoethanol is added to the diet at the same time that the penicillamine feeding is begun, there is a loss of weight for a few days before growth is resumed. On the other hand, there is no break in the growth curve if aminoethanol (at a level of 0.33% in the diet) is used under these conditions.

The animals given L-penicillamine hydrochloride hydrate (0.35%) in the diet without supplementation with aminoethanol, or with any of the methyl derivatives, generally have peculiar seizures at irregular intervals beginning a few days after the diet is first given. Such animals run rapidly about their cages and then collapse in either a clonic or tetanic convulsion, accompanied by salivation. During the running phase, the animals frequently shriek. The animals usually recover within a few minutes from the onset of the symptoms. However, the administration of a larger amount of L-penicillamine (330 mg/kg) by stomach tube or by subcutaneous or intraperitoneal injection is followed within a few hours by seizures of the type just described, and the animal usually dies after a series of violent convulsions. Cyanosis frequently occurs, suggesting that respiratory failure may be the cause of death. Histological investigation of the tissues of these animals is being undertaken.

It is of particular interest that when D-penicillamine, the enantiomorph derivable from naturally occurring penicillin, was employed under any of the conditions described for the L isomer, no inhibition of the growth rate was observed nor was any other toxic manifestation encountered. Of additional interest is the fact that the disulfide of L-penicillamine did not inhibit growth.

The data suggest that penicillamine may exert its toxic action by blocking either the synthesis or the utilization of aminoethanol. However, the possibility of direct reaction between aminoethanol, or a product derived therefrom, and penicillamine is not excluded. At the present time we are investigating the possible metabolic significance of this unexpected relationship between this series of compounds and penicillamine.

[1] The authors wish to thank the Lederle Laboratories Division, American Cyanamid Company, for a research grant which has aided greatly in this work. The authors also wish to acknowledge the kindness of Parke, Davis and Company in placing at our disposal a supply of S-benzyl-DL-penicillamine, which served partially as a source of the penicillamine used in this investigation.

[2] Young albino rats from Rockland Farms, New City, New York, were used for the experiments reported in this paper.

[3] The basal diet had the following composition: vitamin-free casein, 20.0 gm; sucrose, 55.0 gm; hydrogenated vegetable oil, 19.0 gm; corn oil, 1.0 ml; salt mixture (Osborne and Mendel. *J. biol. Chem.*, 1919, **37**, 572), 4.0 gm; DL-methionine, 0.15 gm; vitamins A and D concentrate (60,000 I.U. of A and 10,000 I.U. of D/gm), 12 mg; α-tocopherol acetate, 4 mg; 2-methyl-1,4-naphthoquinone, 0.1 mg; vitamin mixture, 1.0 gm (thiamine chloride, 1.0 mg; riboflavin, 1.0 mg; pyridoxine hydrochloride, 1.0 mg; nicotinic acid, 1.0 mg; *p*-aminobenzoic acid, 1.0 mg; calcium *d*-pantothenate, 1.0 mg; inositol, 10.0 mg; biotin, 0.01 mg; folic acid, 0.1 mg; sucrose to make 1.0 gm). When other substances were added to the diet, this was done at the expense of an equal weight of sucrose. The following percentage levels of the compounds were used in the work reported: L-penicillamine hydrochloride hydrate, 0.35, + sodium bicarbonate, 0.16; choline chloride, 1.6; dimethylaminoethanol, 1.00; monomethylaminoethanol, 0.45; aminoethanol, 0.33.

IN THE LABORATORY

Preparation of Standard Films of DDT Crystals for Toxicity Studies

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The preparation of dry films of crystalline insecticides is a frequent necessity among investigators concerned with studies of toxicity and mode of action of toxicants. With the advent of the complex organic compounds which have been introduced to the field, the problem of preparing standard films of dry crystalline material which will remain uniform from day to day has become important.

Various techniques have been used in the preparation of such films with DDT; however, any method which involves solution and subsequent precipitation of the compound results in the deposition of supercooled droplets of material and the slow growth of crystals. This leads

A B

FIG. 1. Typical dispersions of DDT/mm²: A—25% DDT by weight, B—50% DDT by weight.

to a constant change in the nature of the film deposited and size of the crystals. When dry DDT crystals are dispersed in a dust tower without a diluent, the tendency toward clumping makes it difficult to achieve a uniform film.

To obviate these difficulties a very simple technique has been devised. It consists of formulating the dry crystals, which have been sorted to the desired size range, by mixing them with soluble starch. The dust with the starch carrier is blown into a settling tower with an air stream, and samples are collected on glass plates which have been treated with a very thin film of Mayer's albumin. The plates are prepared in the same manner as are slides for mounting histological sections. The starch can be removed quantitatively from the films by washing in running water. Dispersions of the insecticide can be controlled by varying the per cent-by-weight composition of the dust formulation. The photomicrographs shown in Fig. 1 illustrate the crystal dispersion per square millimeter achieved with 25% and 50% formulations prepared according to this technique. The tendency for the crystals to agglomerate in formulations containing more than 50% DDT limits the preparation of films with a higher number of crystals per unit area.

This method is satisfactory for the preparation of DDT films and can be applied to any other insecticide which is insoluble in water, which can be prepared in a stable crystalline form, and which exhibits the property of supercooling when precipitated from solution.

Simple Preparation of Transparent Scales[1]

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Department of Chemistry
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The Beckman infrared spectrophotometer records values of transmitted energy directly onto a strip chart. The calculation of percentage transmission involves comparison of incident and transmitted energy at many wavelengths and becomes tedious when individual energy values must be read from two separate charts.

Willis and Philpotts (*2*) suggest the use of transparent scales which can be placed directly on the recorded chart and from which a direct reading of the percentage transmission can be taken. The two records can be placed side by side on the chart by rewinding after the initial run. Their scales were made by a photographic process from a drawn master copy, with subsequent reversal onto a transparent film of the desired size. The process requires photographic equipment for handling large-sized film, and care must be taken to avoid distortion during the process.

In a recent article Neuberger (*1*) suggested a technique for making lantern slides from cellulose acetate "Permafilm (dull)."[2] This technique can be modified slightly for preparing transparent scales and graphs of any size or type. The "Permafilm," cut slightly oversize, is mounted carefully on a sheet of clear Cellophane and smoothed to remove air bubbles. The desired chart or scale is drawn directly on the dull surface of the "Permafilm" in India ink. A cleaner line can be drawn if the surface is scoured gently with an eraser or a wet piece of cleansing tissue or cloth. The completely dry drawing is then covered with a sheet of "Permafilm" for protection and the edges are trimmed.

The resultant sandwich is flexible, quite transparent, has a low reading error, slides easily, and is quickly made without special equipment. It does not seem particularly

[1] This work was part of a research program supported by a Research Corporation Grant-in-Aid.

[2] Denoyer-Geppert Company, 5235 Ravenswood Avenue, Chicago 40, Illinois.

bject to elongation or other distortion. This type of ale should find many useful applications.

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Continuous Recording of Body Temperatures of Mice

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A record of the body temperature of experimental animals often yields significant information. The usual techniques of thermometry require frequent observations in order that a temperature change of short duration may not be missed. A technique which we have developed for the continuous recording of subcutaneous temperature in mice, using a sensitive recording thermocouple, is described below.[1]

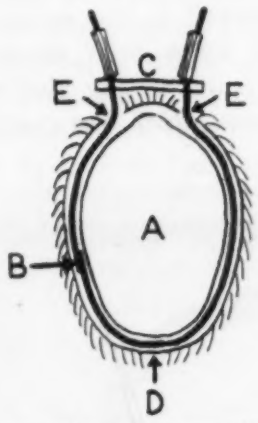

FIG. 1. Cross-section of mouse illustrating location of thermocouple: (A) body of mouse, (B) junction of thermocouple, (C) fiber collar, (D) incision over sternum, (E) incisions over scapulae.

With the mouse under ether anesthesia, three small longitudinal incisions are made: one over the sternum and two posteriorly over the midscapular regions. The thermocouple wire is passed into one of the posterior incisions and manipulated through the subcutaneous tissue to the anterior chest region and around to the other side so that it exits through the second posterior incision. The three incisions are closed by sutures, the thermocouple being left in the subcutaneous tissue of the anterior thoracic region with one wire passing beneath the skin around to the posterior thoracic region of each side (Fig. 1).

The wires are passed through a fiber yoke which is attached to the fur on the back of the animal with collodion. This serves to keep the wire leads from contact with each other. Small cylindrical glass beads, approximately ¼" long, are threaded onto each wire for a distance of about 5", thus providing adequate insulation for the wires and preventing tangling and breaking of the leads when the animal moves about. The beads are prevented from separating by knotting the wire after the last bead has been threaded (Fig. 2).

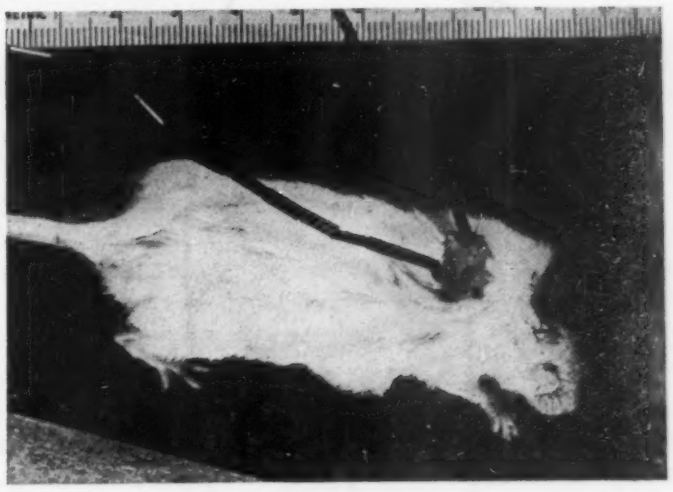

FIG. 2. Lateral view of mouse with thermocouple in place.

The animal is placed in a mason jar of suitable size with a wire mesh insert in the screw-top ring. The lead wires are led through short pieces of rubber tubing secured in this mesh and connected to the terminals of the recording device (Fig. 3). By the use of a Speedomax multiple-point recorder it is possible to record the temperatures of as many as 10 animals simultaneously.

FIG. 3. Method of housing mouse when connected to recording thermocouple.

This method provides a means for the accurate recording of body temperatures of mice continuously over

[1] Thirty-gauge iron Constantan enameled wires, silver soldered to form a thermocouple junction, were connected to a Leeds & Northrup Company Speedomax recorder.

periods of a week or longer (Fig. 4). Mice prepared in this manner are able to move about without apparent discomfort. It is not necessary to disconnect the thermo-

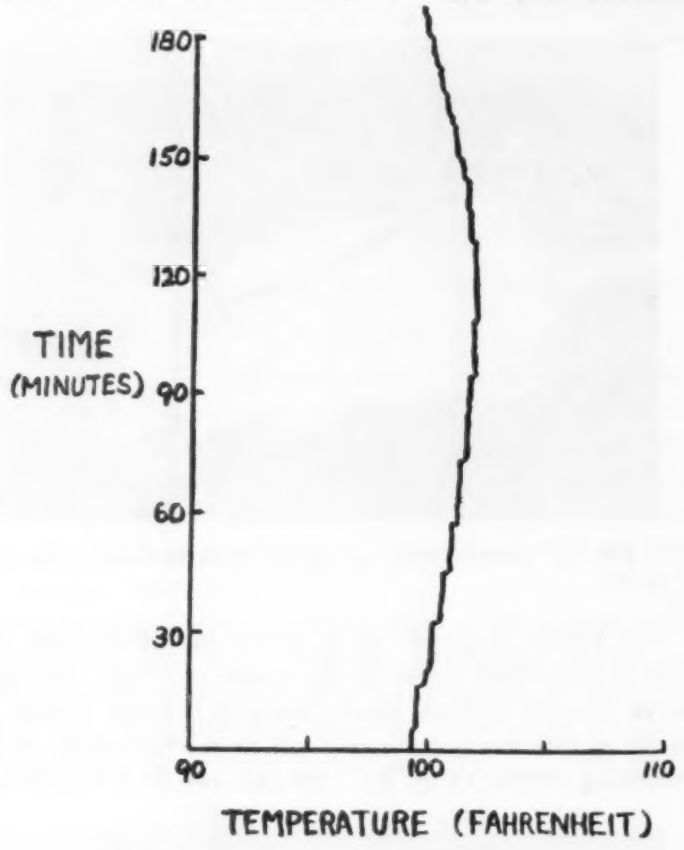

FIG. 4. Sample of temperature record.

couple to permit handling, feeding, or injection of the animals.

If, in the course of any particular experiment, the animal fails to show a variation in temperature, a pyrogen should be injected before disconnecting the apparatus. A prompt rise in temperature will demonstrate the fact that the apparatus would have recorded a temperature change had one occurred.

This technique is readily adaptable to other experimental animals and should prove of great value in work where temperature records are desired.

A Method of Securing Living Mosquitoes to Mounts in Studies of Problems Concerning Flight

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While investigating the effects of reduced atmospheric pressures on wing vibration in *Aëdes notoscriptus* (*Culicidae*), use was made of the stroboscopic technique developed by Williams and Chadwick (*1*). The apparatus was modeled on that of the above authors, and a full description of it will be found in their paper. Initial difficulty was encountered in suitably attaching mosquitoes to the necessary mounts without injuring them or interfering with the normal flying attitude. In the method of Williams and Chadwick the insect under examination is fastened to the free end of a narrow strip of paraffined paper, the tip of this mount being fused to the dorsal posterior part of the insect's abdomen. This technique, while satisfactory in dealing with relatively robust insects such as *Drosophila*, proved inadequate when applied to mosquitoes. The latter insects have a delicate articulation between the thorax and the slender abdomen. Thus, when they are attached to any form of mount by the abdomen, the anterior part of the body is unsupported and hangs downward. Any flight movements are sporadic and unnatural, as the normal flying attitude cannot be attained.

The solution seemed to lie in having the connection between mount and insect at the thorax rather than at the abdomen. A ventral attachment was rejected as undesirable, as it interfered with the response from the tarsal stimulus used in initiating flight movements. The obvious alternative, a dorsal attachment so placed as not to interfere with the flying attitude, was tried and found satisfactory. A mount of 36-gauge brass wire was so bent as to curve down onto the anterior part of the mesonotum of a mosquito, without entering the field of vibration of the wings or affecting the position assumed by the legs during flight (Fig. 1).

Before being fastened to the mount, a mosquito was lightly anesthetized by a brief exposure to ether. A minute quantity of quick-setting glue was placed on the tip of the curved wire, which was gently pressed against

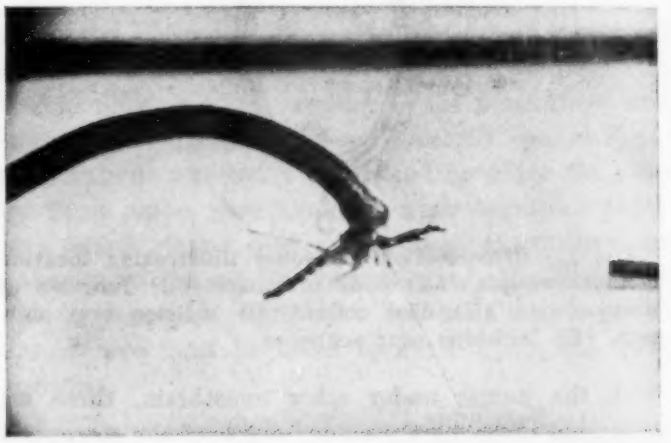

FIG. 1. *Aëdes notoscriptus* in flying attitude, while attached to mount.

the insect's mesonotum. By the time the mosquito had fully recovered and regained its ability to fly, the glue had set, fixing it firmly to the mount.

At the conclusion of a series of flight observations, an insect so mounted can be freed by sharply tapping the wire support. Ten mosquitoes, all 14 days old when attached to mounts, lived for periods ranging from 24 to 65 days after being returned to their feeding tubes. Their ages at death averaged 65 days. As the average life of 10 control insects was 71 days, no significant reduction of life-span resulted from the use of the mounting technique.

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Book Reviews

An introduction to the theory of seismology. K. E. Bullen. Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1947. Pp. xiv + 276. (Illustrated.) $4.00.

Addressed to any who are interested in seismology as a branch of applied mathematics, as well as to observatory seismologists, this splendid volume presents an introduction to seismological theory in compact, well-organized form. Most of the material in the first 8 chapters is of general interest in mathematical physics.

The author, professor of applied mathematics in the University of Sydney, is an outstanding authority on this subject. He starts with two chapters on mathematical theories of elasticity and of vibrations and waves. The treatment is, of necessity, brief. Use is made of Cartesian tensors and the summation convention, though previous knowledge of tensors is not required since very little actual tensor theory is used beyond what is needed for an understanding of the stress and strain tensors. In the next five chapters, wave theory is applied to problems of wave motion in an elastic body. The following chapters are more directly devoted to results special to seismology. To an observatory seismologist, the discussions of seismic rays and construction of travel-time tables are particularly important, coming as they do from the co-author of the standard Jeffreys-Bullen Seismological Tables.

Every seismological observatory should have one or more copies of this book, and it is recommended to students of applied mathematics, whether they have an interest in seismology or not.

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A laboratory manual of comparative vertebrate embryology. Allyn J. Waterman. New York: Henry Holt, 1948. Pp. viii + 248. (Illustrated.) $3.50.

This manual is handled in such a way that it replaces partly class material and partly textbook. The exercises are so numerous, exhaustive, and well illustrated that the student will be able to work independently with a minimum of aid from the instructor. As background, the undergraduate should have, in addition to the elementary first course in biology, a class in comparative vertebrate anatomy. The manual contains so much material that the lecturer or the student may use it for several courses with a lot of variety. Each exercise is organized in the following sequence: an introductory part summarizing and reviewing some of the standard knowledge of the topic under consideration, exercises for laboratory study, list of references and suggestions for collateral reading, and, at the end of each chapter, a list of questions for review.

For the most part, the material chosen is readily available or can be easily prepared by student or instructor. Methods of obtaining certain materials are explained as well as the ways and means for cultivating living chick embryos, constructing models, obtaining young stages of rabbit, making vaginal smears for the study of estrous cycles, preparing embryo sections, etc. Throughout the book the use of living material is emphasized, the number of stained preparations being consequently reduced.

Waterman also describes the value of accuracy in the case of drawings. These should be made directly from the object and completed in the laboratory in order to avoid diagrammatic, unscientific, and faulty work. He recommends that drawings be made of the selected structure at each stage examined, that each be labeled fully, and that the age of the embryo be recorded, careful note being made of any change in shape, size, and degree of differentiation.

In the last chapter, entitled "Illustrations," are included more than 300 photomicrographs accompanied by explanatory legends for finding and interpreting the desired material. Some are unlabeled for student diagnosis.

Both text print and reproduction are excellent, and the methods set forth in this manual will be highly appreciated.

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Statistical methods in research and production, with special reference to the chemical industry. Owen L. Davies. (Ed.) London-Edinburgh: Oliver & Boyd, 1947. Pp. xi + 292. 28/–.

This book was prepared jointly by seven authors, including Davies, the editor. The object of the book, referred to as a "Handbook," is "to bring together under one cover those statistical methods which are most likely to be of use in the Chemical Industry." It is to be followed by a second volume on the "planning of experiments."

Many chemists who, through the particular nature of their work, have felt, at one time or another, the advisability of becoming acquainted with statistical methods may have been repulsed by the inadequacy, from their viewpoint, of the available books in this field. This certainly is regrettable, inasmuch as statistical thinking and the use of statistical methods should contribute materially to rendering more objective and efficient the experiments of those engaged in chemical research and production. The present book, at last, is a readable presentation, from the chemist's point of view, of the fundamental principles and methods required for the successful application of statistics to the chemical field. In fact, any person with a background in any quantitative phase of science and with only high school mathematics is likely to have his interest in statistics aroused by the reading of this book. Unlike many books on statistics, it does not contain a series of antiquated, erroneous, or useless concepts and introduces only such definitions and explanations as are used and illustrated in later chapters.

Computational methods are duly emphasized and amply illustrated by means of numerical examples worked out in detail.

The 9 chapters of this work following the introduction cover successively the following topics: "Frequency Distributions"; "Averages and Measures of Dispersion"; "Tests of Significance"; "Analysis of Variance"; "Regression and Correlation"; "Frequency Data and Frequency Tables"; "Sampling"; "Control Charts"; and "Prediction and Specification." A glossary of statistical terms and important tables are included.

In this reviewer's opinion, the outstanding chapters are those on "Analysis of Variance" and "Regression and Correlation"—especially the latter, in which linear regression is treated in a modern and practical fashion. Two types of regression are covered in detail. Perhaps the choice of the titles "Rubber Testing Type Regression" and "Penicillin Type Regression" to denote these two types is not a fortunate one. It seems reasonable to expect that such fundamental concepts not be made dependent on casual applications. This chapter has, as another laudable feature, a clear exposition of the treatment of regression by means of the methods of variance analysis.

The statistically trained reader may find that many of the topics mentioned in this book are treated in a somewhat sketchy manner. One could not expect, however, that all statistical methods useful to the chemist or the engineer would be exhaustively covered in less than 300 pages of text. Nevertheless, this reviewer believes that the inclusion of an introductory chapter on the principles of statistical design would have enhanced the value of the book, inasmuch as it would have shown the chemical reader the intimate relationship between the statistical design of an experiment and the statistical interpretation of its outcome. One therefore looks hopefully forward to the appearance of the second volume announced by the editor.

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